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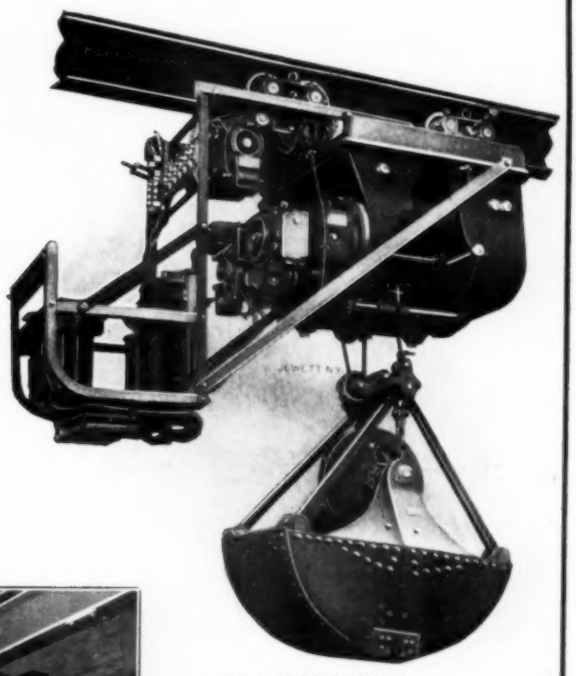
Index to Advertisers and Classified Index Following Reading Matter.

SPRAGUE ELECTRIC HOISTS

S-1 HOIST
TON CAPACITY



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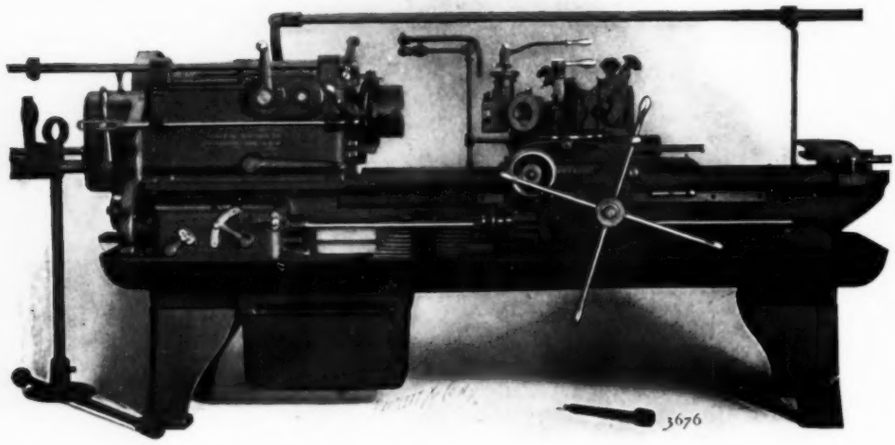

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Welding by Means of the Electric Arc

Two Methods Are Used—Both Fuse the Metals to Be Welded with an Electric Arc—Operation Is Simple, Trained Workmen not Required

BY C. B. AUEL*

The welding of steel castings by the electric arc is coming more and more into general use, both in foundries and in machine shops, for its effectiveness, simplicity and cheapness are commencing to be realized. There are two such processes of welding, namely, the Zerener and the Benardos; the latter is by far the more common.

Zerener Process

The Zerener process employs two obliquely held carbons which are made to approach or to recede from each other by a suitable mechanism; the arc meanwhile bridges the gap between and at the same time spreads out into the shape of a fan under the influence of a controlling magnet. The type of electrode used is illustrated in Fig. 1, taken from Glaser's Annalen, Volume 60, 1907, "Schweissen und Loten. Elektrische Schweissmaschinen fur Massenfabrikation," vom Kgl. Regierungsbaumeister Peter, Berlin. In this process the metal to be welded is brought into contact with the arc and the contact maintained until the melting temperature is reached, when the welding is readily completed.

Benardos Process

The Benardos process makes use of but one carbon; the arc is sprung between it and the metal to be welded. When the metal is brought to the proper temperature, the welding is completed as in the Zerener process. Fig. 2 shows the electrode employed.

For small work and for work where a certain degree of accuracy and refinement are necessary, the Zerener process will give rather better results than the Benardos, for the reason that in the former the arc is, comparatively speaking, under close regulation, while in the latter there is only such regulation as may be obtained by hand. Nevertheless, for general work the Benardos process, on account of its simplicity, is to be preferred.

Apparatus

The apparatus should include a suitable direct-current supply, a rheostat, carbon electrodes, fireclay or carbon blocks for molding purposes and a stock of iron rod, broken castings, or punchings of boiler plate to serve as filler.

It is necessary to conduct the welding in an inclosure, as the intense rays of the arc seriously interfere with any other work in the immediate vicinity. For a similar reason, when the Benardos process is employed, the welder should be thoroughly shielded, eyes as well as body. A head-gear of canvas, or of stovepipe, is readily made and fitted with a small projecting window of thick colored glass. Gloves provided with long gauntlets will answer for the hands while the ordinary clothing, if not too thin, will suffice for the rest of the body. Exposure to the direct rays of the arc causes an irritation of the skin in effect much like sunburn; the skin reddens, and subsequently peels, but with no more serious consequences. A short trial will, however, be more effective in demonstrating the desirability of care in this matter than any words of caution.

FIG. 1. TYPE OF ELECTRODE USED IN THE ZERENER PROCESS OF ELECTRIC-ARC WELDING

When the Zerener process is employed, however, the welding is usually on a much smaller scale, and it is then only necessary to protect the eyes by a pair of suitable colored glasses.

There are several ways in which the current may be obtained, namely, from a 100- to 125-volt, or even a 220-volt supply circuit (though the latter is very wasteful), from an independently driven generator, or from a battery operated in conjunction either with a generator or other supply circuit. Each of these has one or more points in its favor such as reduced first cost, simplicity, low maintenance, adaptability, and non-interference with or from other portions of the electrical plant. The particular method to be employed can, in consequence, be determined only after a full knowledge of conditions, including the volume and the continuity of the welding to be done. With the Benardos process, the supply should be not less than 75 to 100 kilowatts at 100 to 125 volts. With the Zerener process a smaller capacity will answer. If an independently driven generator is employed, it may be either shunt- or compound-wound, belted or direct-connected; when direct-connected a flexible coupling should be used in order to prevent armature burn-outs. Fig. 3 shows a 200-kilowatt motor generator connected by a flexible coupling of the style indicated.

For the control of the current, in addition to the rheostat, a simple switchboard will be required on which should be mounted, somewhat as in Fig. 4, a voltmeter, ammeter, circuit breaker, and single-pole switch. If the generator is driven by a motor, one or two additional instruments will be required; these, however, will not be necessary if the generator is driven by an engine. The rheostat may be of the grid type, such as shown in Fig. 5, or a couple of substantially built watertight barrels, like those in Fig. 4, will do as well. The drawback to the use of the latter is that the water will occasionally boil over, and the hoops in time rust away, necessitating the renewal of the barrels. When using the grid-type rheostat it is advisable to have it so divided that by opening or closing one or more single-pole switches, the resistance may be increased or diminished to suit the work being done. When the water-type rheostat is used the same result is accomplished by providing the cables entering and leaving the barrels with suitable terminals of about ¼-inch steel plates, fashioned somewhat to the shapes shown in the diagram, Fig. 6. One of the

*Manager, railway department, Westinghouse Electric and Manufacturing Company.

triangular plates is suspended by pulleys over each barrel so that it may be readily raised or lowered and thus regulate the current. As the lower plates wear away much faster than the upper ones, it is sometimes convenient to use discarded steel castings instead; these should weigh from 20 to 30 pounds each, and be as compact as possible in order to occupy the minimum amount of room in the barrels.

Diagram of Electrical Connections

The diagram of connections used with the Benardos process is given in Fig. 6. In this diagram it will be observed that the positive cable of the circuit runs from the source of supply to the switchboard, through the ammeter, the circuit-breaker, thence through the resistance (in this case the barrel-type rheostat has been chosen) and finally to a metal table to which it is securely fastened. It is sometimes convenient to omit the table; then the cable is fastened directly to the casting to be welded. The negative cable runs from the source of supply to the switchboard, and through the single-pole switch to the carbon electrode.

In the Zerener process the metal table and the single-carbon electrode are replaced by the double-carbon electrode, shown in Fig. 1, to which are attached both the positive and negative cables.

Carbon Electrodes

Some difficulty may be met with in finding suitable carbons for the electrodes as many carbons have a tendency to crumble away, owing to the severe treatment to which they are subjected when welding and being heated and cooled in rapid succession. For general use the carbons will vary from ½ to 1½ inches in diameter by 6 to 12 inches in length. They should be hard and uncored; in burning away they should leave a rounded end instead of a long pencil point.

Method of Making a Weld

In welding by the Benardos process it is more convenient, provided the castings run in quantities and have a flat machined surface and are not too large, to make use of the metal table previously mentioned. As the table is already connected to the positive cable, it is only necessary to lay a casting upon it machined side down, without any further contact being required. If, however, the casting is rather too large, or has no such machined surface, the cable must then be clamped directly to it. The positive instead of the negative cable, should always be thus clamped to the table, or to the casting, in order that the current may flow from the casting to the carbon electrode. By

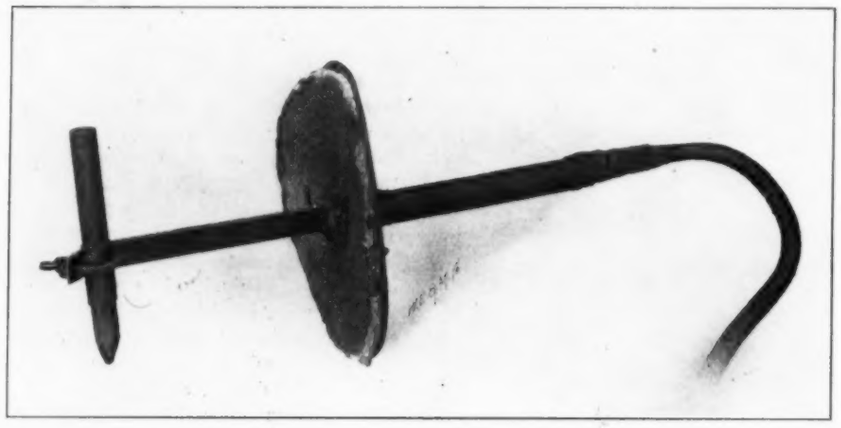


FIG. 2. TYPE OF ELECTRODE USED IN THE BENARDOS PROCESS OF ELECTRIC-ARC WELDING

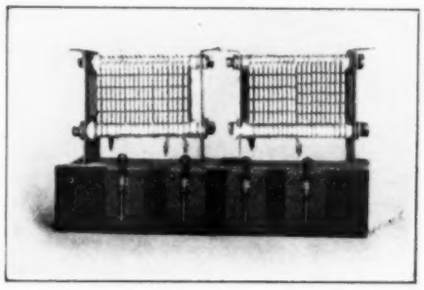


FIG. 5. A GRID TYPE OF RESISTANCE USED FOR ELECTRIC-ARC WELDING

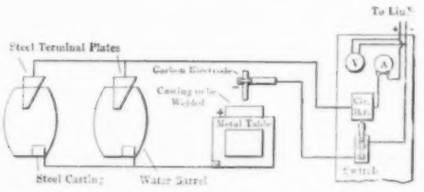


FIG. 6. DIAGRAM OF ELECTRICAL CONNECTIONS USED IN BENARDOS PROCESS

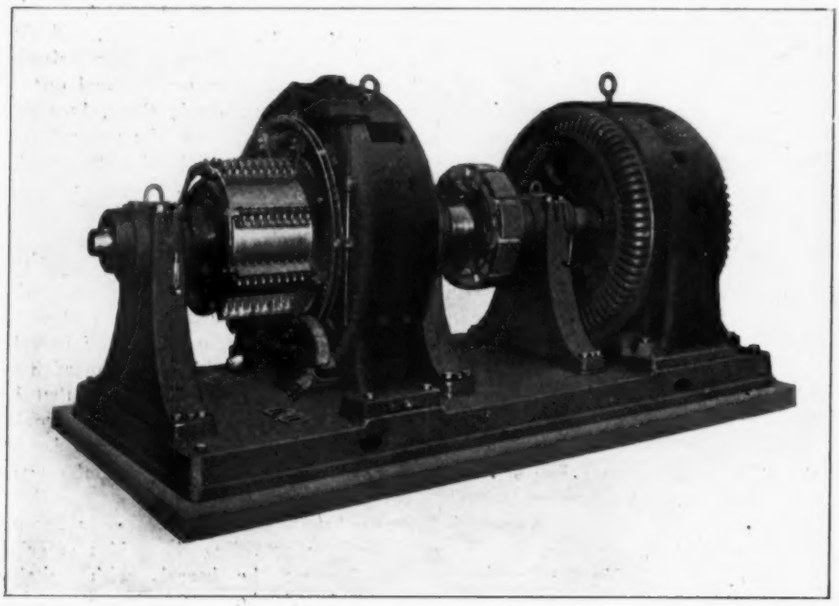


FIG. 3. A 200-KW. MOTOR-GENERATOR SET WITH A FLEXIBLE COUPLING SUCH AS IS USED FOR ELECTRIC-ARC WELDING

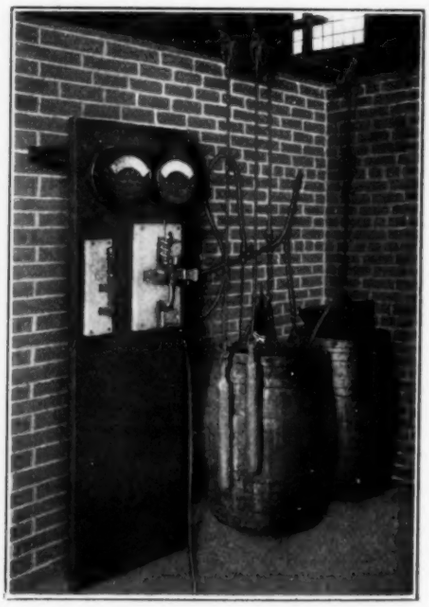


FIG. 4. WATER RESISTANCE AND SWITCHBOARD FOR ELECTRIC-ARC WELDING

so doing particles of carbon are largely prevented from entering the casting and producing a hard weld when the electrode is vaporized during the welding process.

Assuming now that everything is in readiness for making a weld, the operator places himself in front of the casting, holding in one hand the carbon (negative) electrode by means of an insulated handle and having within convenient reach of the other hand the material to be used as filler, either iron rod (norway iron ¼ to ⅜ inch preferred), bits of broken steel castings, or small punchings from boiler plate. He then pulls the hood down over his head, touches the carbon electrode to the casting, as shown in Figs. 7 and 8, thereby closing the circuit, and thus producing the arc. As soon as the arc is sprung the carbon electrode should be withdrawn to a distance of at least 2 inches, more if possible, and the arc continued until the melting temperature of the metal is reached.

If it is not possible to maintain the arc at the proper distance, or if it is too intense, the depth of the triangular plates in the water rheostat, or the number of grids in the resistance, should be altered accordingly. The arc instead of being

Brand and Size. F = Fire-welded. E = Electric-welded.		Ultimate Tensile Strength Per Sq In. T.	Contraction of Area at Fracture. C.	Extension in Ten Inches.	Ratio of Weld to Solid.	Figure of Merit. T × C.
Brand.	Inches.	Tons.	Per Cent.	Per Cent.	Per Cent.	
Lowmoor iron	2 × 5/16 F	20.3	15.2	7.3	77.9	308
	2 × 5/16 E	21.1	17.3	7.3	81.1	365
Lowmoor iron	2 × 5/16 F	21.5	22.3	11.3	90.7	479
	2 × 5/16 E	21.8	20.7	9.7	91.8	451
Netherton best iron	2 × ¼ F	18.4	10.1	3.4	84.4	185
	2 × ¼ E	20.1	10.8	4.5	92.0	217
Park Gate steel	2 × ⅜ F	20.9	9.3	1.9	69.1	194
	2 × ⅜ E	22.3	18.4	3.8	73.6	410
Park Gate steel	2 × ½ F	20.4	15.9	8.1	82.3	324
	2 × ½ E	21.0	15.4	7.3	86.4	323

Average of electric-welded bars = 1766 / Average of fire-welded bars = 1490 = 118.5 per cent.

MEAN RESULTS OF TESTS OF FIRE-WELDED BARS COMPARED WITH ELECTRIC-WELDED.

Line Volts.	Amperes.	Volts Across Rheostat.	Volts Across Arc Including Carbon.
126 (open circuit)	....	..	..
102	550	38	63
102	500	36	65
102	550	39	61
98	600	42	53
97	650	44	51
97	650	45	50
102	600	42	58

Size of hole = 1½ inches diameter x 2 inches deep. Size of carbon = 1½ x 6 inches. Time = 56 seconds.

BENARDOS PROCESS—FILLING DRILLED HOLE IN AXLE CAP (FIGS. 9–10–11).

120 (open circuit)	....	..	..
95	600	34	62
98	650	30	67
100	600	31	67
95	850 (kick)	30	64
100	550	30	71
100	850 (kick)	35	63

Cross-section of sink head = 2¼ x 6 inches. Size of carbon = 1½ x 6 inches. Time = 4 minutes 45 seconds.

REMOVING SINK HEAD FROM AXLE CAP (FIG. 12).

120 (open circuit)	....	..	..
98	430	23	72
102	400	22	81
104	370	20	86
85	1000 (kick)	24	60
87	1000 (kick)	23	65

Size of hole = 1¾ inches diameter x 1¼ inches deep. Size of carbon = 1½ x 6 inches. Time = 3 minutes 30 seconds (includes 45 seconds for reversing plate).

BURNING HOLE IN WROUGHT-IRON PLATE (FIG. 13).

FIG. 7

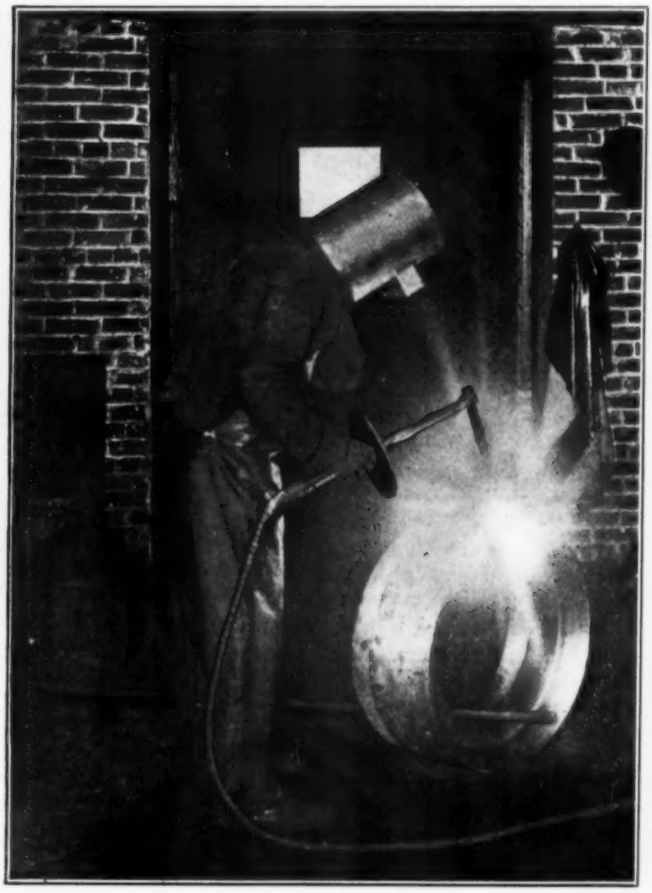


FIG. 8

THE BENARDOS PROCESS IN USE

concentrated on one spot should be given a rotary motion in order to heat the casting thoroughly in the vicinity of the proposed weld.

When the melting temperature is reached, either the iron rod, small bits of steel castings, or punchings of boiler plate are fed into the boiling metal. This feeding is continued, the arc meanwhile also being maintained, until the weld is completed. To make the casting conform to a particular shape, or to give it a smoother finish, or a closer grain, the surface of the weld may be hammered while cooling.

Whenever practicable, the weld should be made during one continuous application of the arc. This will prevent scale, which would otherwise form, from entering into the casting and producing a hard weld. As, however, it is sometimes impossible to make a weld in one application of the arc, the scale should be removed from the casting by hammering and brushing with a stiff wire brush. Similarly, before commencing a weld the surface of the casting should be clean and free from slag. Where chipping will not readily accomplish this, the arc may be applied, the casting first being tilted to such a position that the dirt or slag will run off by gravity as fast as melted.

When building on a lug, or welding a piece to the casting, some means must be provided for confining the molten metal within certain limits; for this purpose, fireclay or carbon blocks may be used; the latter generally consist of worn-out dynamo or motor brushes. The fireclay is formed to shape by hand; the carbon blocks by a knife. Figs. 9, 10 and 11, reproduced from the *Electric Journal* (January, 1908), show a defective bearing cap before and after welding and the method of preparing the clay mold.

In the Zerener process practically the same procedure is followed. As before mentioned, the work is on a much smaller scale, the arc is sprung between the two carbon electrodes and the casting to be welded is brought into intimate contact with it.

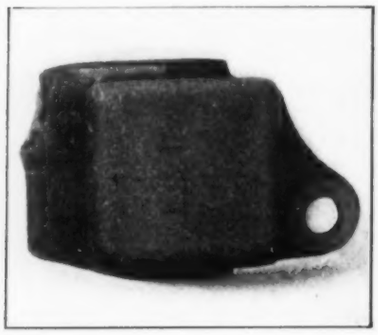


FIG. 9

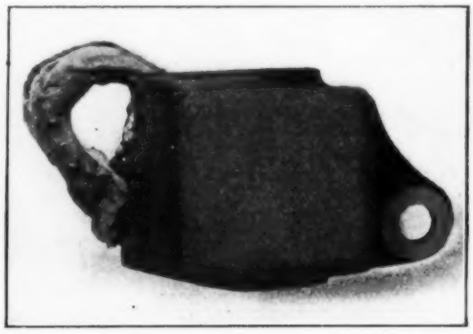


FIG. 10

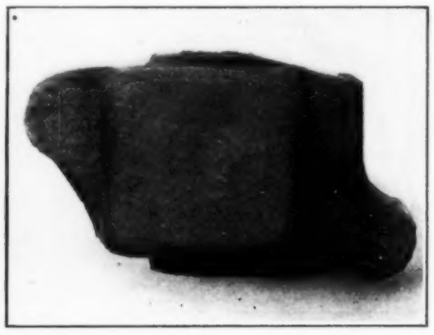


FIG. 11

A DEFECTIVE BEARING CAP BEFORE AND AFTER WELDING AND ITS CLAY MOLD

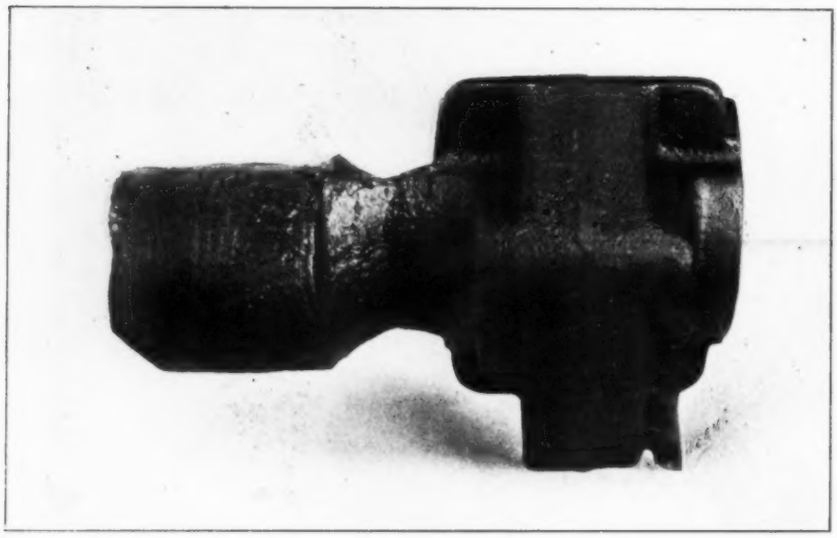


FIG. 12. SINK HEADS ARE FREQUENTLY REMOVED BY THE ELECTRIC ARC

Welds made by the electric arc sometimes prove very much harder than other portions of the castings. These are in large measure due to the non-observance of one or more of the rules already enumerated, namely:

a. In the Benardos process (1) the casting should be made the positive terminal, the carbon electrode the negative terminal; (2) the arc should be as long as possible, not less than 2 inches, preferably 4 to 6 inches, and should not be concentrated on one particular spot, but given a rotary motion.

b. In either the Benardos process or the Zerener process (1) the casting should be freed from dirt and slag before welding and kept free during welding.

Where no machining is involved it is, of course, immaterial whether the weld is hard or soft; where, however, a hard weld is detrimental it may be either remade or else annealing may be resorted to.

Physical Characteristics of the Welds

The tensile strength of properly made welds will average 70 per cent. or more of the strength of the original material. As illustrating this feature, as well as enabling a comparison to be made of fire-welded *versus* arc-welded iron and steel bars, certain results are given herewith, taken from a paper by Samuel MacCarthy on "Steel Steam Pipes and Fittings and Benardos Arc Welding in Connection Therewith," read before the Institution of Mechanical Engineers (England).

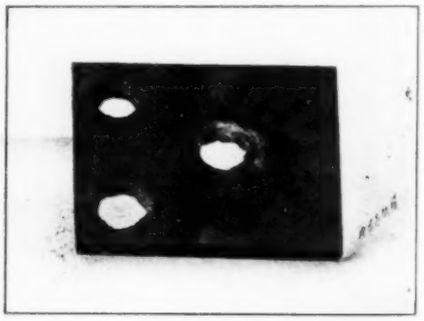


FIG. 13. HOLES CUT BY THE ELECTRIC ARC

All of the bars were scarf-welded; the length of the scarf ranged from 1¼ to 1½ inches. It is of exceeding interest to note that on the basis of "figure of merit" there is a difference of 18.5 per cent. in favor of the arc-welded bars.

Other Applications

The processes described in this article may also be advantageously employed for

work other than the welding of steel castings. The Benardos process, for example, is sometimes used to remove sink heads (see Fig. 12) from castings, whether of steel, iron, or brass; to bore holes (see Fig. 13) in castings and plates, and to weld flanges, elbows and couplings to wrought-iron or steel pipes.

While it will not cut metal so fast nor so clean as a good machine tool, yet taking into account the time required to set up large castings in position before a saw or a drill, the electric arc will quite often be found the quicker method.

The Zerener process may likewise be used for the welding of sheet-iron or steel plates and also for soldering.

One of the most novel applications of the electric arc occurred as a result of the great San Francisco (1906) fire. A certain building was in course of construction. Considerable stores of pig lead had melted and run down into the cellar where it had spread over the floor in a sheet several inches thick. The removal of this lead, which threatened to prove an exceedingly laborious and expensive undertaking, became a comparatively easy matter when the electric arc (Benardos process) was used; the metal was cut into convenient blocks and carried away.

Data

Owing to the nature of the work and the variables which enter in, it is almost impossible to give any exact data as to current, size of weld, and time of making. Several examples are, however, offered as being approximately correct.

In conclusion, it may be stated that the Benardos and the Zerener processes will give equally satisfactory commercial results, though each has its particular field. The apparatus required has been thoroughly standardized and neither process involves any new principles. A workman of average ability can accordingly be readily given the few instructions necessary, and at the end of a couple of weeks' practice, will become sufficiently expert to turn out good work.

Machines for Tapping Pipe Fittings

The tapping of pipe fittings is a little out of the usual run of machine-shop work and the machines shown are specially interesting on that account. Fig. 1 is a three-way tapping machine with five heads, although the third head is not in place on the three heads at the right. These are for T's, elbows, connecting bushings and similar work. Fig. 2 shows a cross-sectional view so that the details of construction can be readily seen.

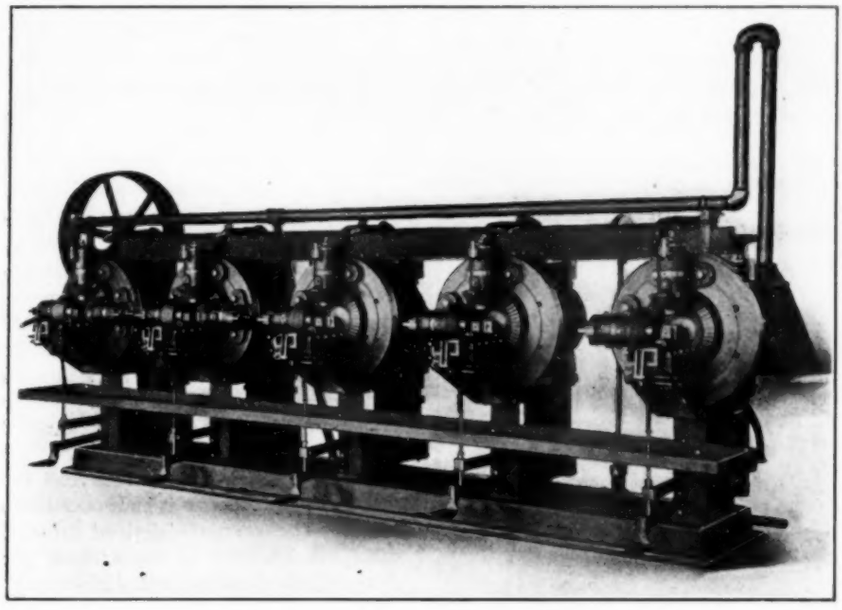


FIG. 1. THREE-WAY TAPPING MACHINE

These machines are entirely automatic, except the placing or feeding of the work. After the work is placed in position, the machine is started and the complete operation is finished and the machine stops without any attention of the operator; he, therefore, is at liberty to operate as many machines as he can, while machine is at work. This number depends upon the time it takes to do the work and the time it takes operator to place the work; the number of machines used in practice varies from two to six.

Each machine is absolutely independent as it can be started, stopped, adjusted or changed, without interfering with the others. This allows all adjustments, etc., to be made by a floor man, while the operator keeps on with the other machines, an advantage of this over combined machines when all stop at once. It also allows machines to be installed in sections, new ones being added as occasion requires.

Every necessary part is adjustable. The number of revolutions to tap a fitting can be adjusted to suit the length of thread to be cut, and the spindles are so made that they can be adjusted, while machine is in motion, to within a quarter of a thread, and the stopping and reversing mechan-

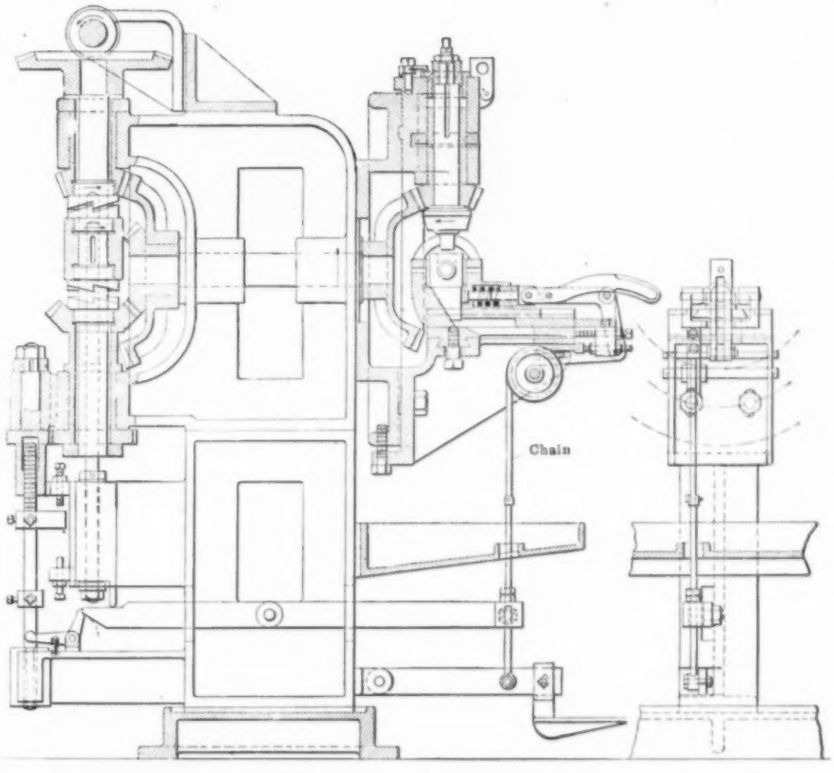


FIG. 2. SECTION OF THREE-WAY TAPPING MACHINE

ism is so sensitive that it is claimed fittings will not vary from gage, one-sixteenth of a revolution. The tapping heads are adjustable to any angle from 0-180 and the change can be made almost instantly.

The chuck is also adjustable, being of the floating type, gripping the fitting firmly, but allowing motion in any direction in the horizontal plane; this allows taps to center themselves in center of holes and insures fittings with full threads. The chuck is also adjustable vertically, to insure correct position of jaws. It is of toggle-joint type and positive in its motion, is adjustable to varying sizes of fittings by a spring, which causes uniformity in pressure, so that the operator does not have to make two efforts or more to close the chuck. The driving, reversing and gaging mechanism is a separate and distinct part of these machines. The novel feature of this mechanism is the quick return of tap; this is always three times the tapping speed. The driving mechanism is so designed that when the machine has completed its work, it stops automatically, and there is, therefore, no danger for the operator, while engaged in putting the work in the machine after the work is placed. The machine is started by the foot lever after the operator has left the machine. Safety is provided for by "breaking" pieces on each spindle; when any obstructions in the fitting or accidental misplacing of work or chuck, these pieces break and release spindles from any forward movement and the machine stops without any damage being done.

In order to insure straight tapping, it is necessary that tap be held central, in correct alinement, and rigid. This is impossible of accomplishment by means of a shank or set-screw, or a tap held loosely will invariably cut a crooked thread; by use of a tap threaded full length and a special chuck it can be held rigidly and at the same time in perfect alinement, any variations in size of tap not affecting the correct holding. The simplicity, durability and interchangeability of this holder is its special feature, the jaws for different size taps can be taken out and replaced instantly and without taking it apart, every part being absolutely solid. This chuck grips the taps on the thread by jaws threaded to suit with a key in the flute to prevent rotation in the chuck.

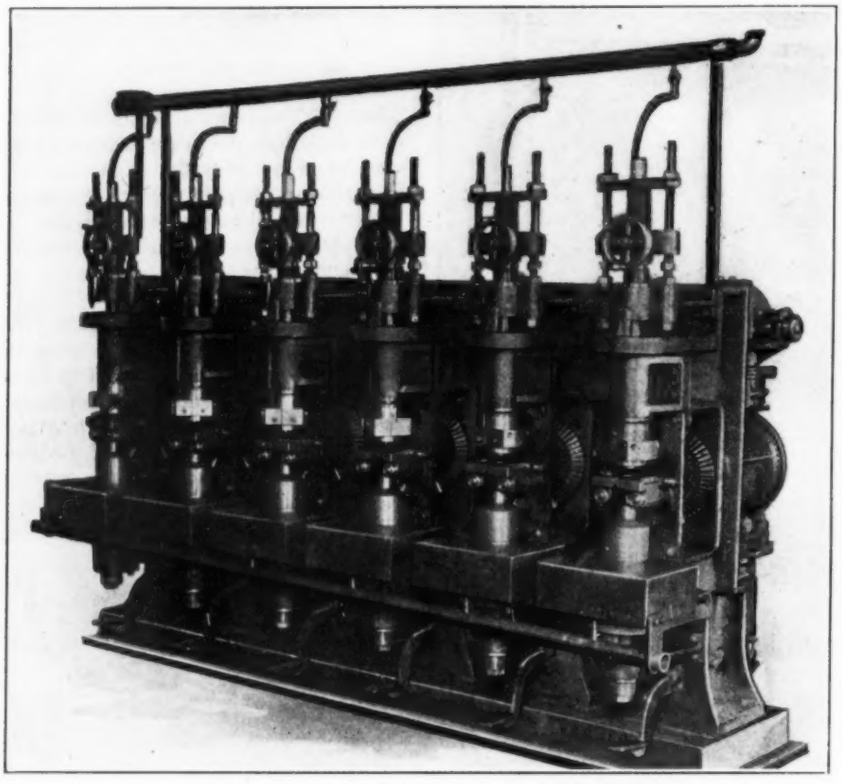


FIG. 3. MACHINE FOR TAPPING BUSHINGS

Any pitch of thread can be cut on any spindle at the same time so that any reduced fitting of different pitches can be tapped at once. This is done by putting separate leaders on each spindle; these are of machinery-steel leaders, working in cast-iron leaders nut, a combination which gives maximum wear with minimum friction. These leaders are instantly removable and replacable, only requiring the removal and replacement of a simple nut. A lubricating system is furnished with each group of machines, to provide for copious lubrication of reamers or taps.

These machines usually occupy a space of about 9 square feet per machine and are usually grouped together in a single or double battery and are preferably driven by a variable-speed motor, but can be as easily driven by belts. They are geared in a high ratio and consume very little power.

Fig. 3 is a machine for tapping bushing in which the die is held stationary and both the work and the tap revolve. The die is in the holder between the upper and lower spindles, one of which carries the tap while the other drives the work.

These machines were designed by H. O. Evans and are built by the Pottstown Machine Company, Pottstown, Penn.

Trade Opportunities in Peru

By M. de Moreira

Peru, though not as large as either Brazil or Argentina, offers, nevertheless, great opportunities to American manufacturers and a still greater one to American capitalists. Financially speaking, Peru obtained a splendid result for the year 1907, inasmuch as her revenues were increased and her expenditures reduced. The receipts amounted to $13,396,330, and the expenditures to $10,535,205.

Here are a few items which will show that Peru's prosperity is built on a serious basis: The revenues derived from the taxes administered by the national company of collections amounted in six months to $2,075,000; the interest on the national debt amounting to $13,300,000, has been paid to date; the claim of the Guano company of the United States has been paid by an issue of $7,385,000 in bonds of the public debt. The report of the Peruvian corporation whose operations for the year of 1907 show a profit of $1,000,000 is another proof of the prosperous conditions of business in the republic.

Before going into details regarding the opportunities within the reach of the manufacturers, I will say a few words regarding the great possibilities for capitalists.

Iquitos, the shipping center of eastern Peru, which imported last year from the United States $3,148,713 worth of merchandise, has no sanitary drainage, no telephone system, and only a small narrow-gage railroad inadequate for the needs of the town. In view of this, it seems to me that a syndicate of capitalists would reap a golden harvest if it would undertake the drainage of the town, the installation of a telephone system, and of an electric-light plant. The Peruvian government, I am sure, would grant valuable concessions to anyone planning this work, and the results would certainly not be small.

Statistics show that American manufacturers have exported proportionally more to Peru than to any other South American republic. The products ex-

ported by the United States in 1907 amounted to the value of $6,876,217, composed mostly of railroad materials and supplies, agricultural implements and general merchandise.

Railroad Opportunities

The Peruvian government is making every effort to increase the railroad facilities of the country and has thus far made Peru a good buyer of railroad materials and supplies. Peru has now eight organized lines, all having their car and repair shops. Though Peru buys her cars in the United States, many of the old cars are rebuilt there, necessitating machine tools, bought until now mostly in England. Another is building from Cuzco to Santa Anna, which goes through the provinces of Colca and Urubamba. The Peruvian corporation of London, which operates the state railways under lease, is carrying out the prolongation and extensions of several lines. Another line, and one that is of the most importance for our manufacturers, is planned to the Amazon via the Ucayali river. This line will require a large quantity of steel rails, rolling stock and other materials. The construction is supposed to begin in August, 1908, and to be finished in 1913. The concession which the Peruvian government has granted is for a standard gage line, which will start near Oroya on the existing railway, and end at a point on the Ucayali river, suitable for steam navigation all the year round for vessels drawing at least 5 feet. A subsidy of about $10,000,000 is provided in 6-per cent. bonds at par value, to be delivered in half-year instalments and in proportion to the number of kilometers finished in the same period. A grant of 7500 acres of land is made for each steamer of 500 tons. Shops are all ready at the Ucayali end to handle the requisite works. So far as I can learn, the shops alone are ready, that is to say, that the machine tools are not yet installed and only few purchased. Isn't this a good opportunity for the American manufacturer to sell his goods to that railroad company?

The maritime movement of the republic is not as progressive; however, a new company of steamers, between Callao and New York, via Panama, is expected to be in full operation this year. Fast steamers are now under construction and the company's intention is to make the run from Panama to Callao in five days instead of the long trip of 13 days required now. That company has also under contract the building of a dry-dock in the Port of Callao.

Mining-machinery Opportunities

The wealth of Peru is naturally in its mines. Here are the last statistics obtainable on their value (1906): Copper, $4,980,275; silver, $4,864700; petroleum, $1,212,710; gold, $851,775.

In 1907 the Cerro de Pasco mine shipped to the United States 10,000 tons of copper out of the 28,000 tons reported from the whole of South America. The famous gold mine, Santo Domingo, of the Inca Mining Company covers 90 working claims and about 63 are not being operated.

As water is abundant the large mining companies are planning to establish an electrical smelting plant. The Cerro de Pasco Company has made extensive investigation of the power which may be obtained in the regions depending to its properties, and the results are said to be very favorable. Within 36 miles of the smelter an available 15,000 horsepower has been located, and at a distance of 55 miles and an elevation of 10,000 feet they can obtain 25,000 horsepower.

Near Lima on the Central railway at a place named Rio Blanco, where Americans have a smelting plant and where 3000 horsepower is available, machinery is being installed for that purpose. Other electric installations are in prospect in the Department of Ancacho, which is the chief mining province of the country. Electrical power is used in a very few towns for tramway transportation, the associated electrical companies supplying power for all the companies of Lima and Callao; however, as Peru has few large cities, this development of electrical power is naturally restricted.

Though there is a prospective application of electricity on a large scale, such as for mines and smelters, there seems to be a more immediate demand for light manufacturing. About 2000 horsepower in five power circuits is now furnished by the trust to the mills and factories of different kinds in Lima and vicinity. Coal is expensive fuel for local industries, and it has been demonstrated that with the water power which is available electricity can be furnished cheaply.

As one will see, there are many opportunities for the machinery and machine-tools manufacturers. Bank facilities, however, are not very convenient. This could be easily arranged as there are enough American houses in Peru or houses doing a large business with the United States who would, for a regular banking commission, look after the interests of the manufacturers. There is one thing, however, which the American manufacturer must beware of and that is the New York commission house through which a great part of his goods are sold. The commission they charge (the real commission, I mean, not the apparent one) is so high that added to the excessive freight rate often renders the price of American products prohibitive.

I should recommend that American manufacturers follow the example of the English, French, Belgian, German and Portuguese houses and send personal representatives, thus securing more business and also being able to sell their goods at lower rates.

Machinery Building in Japan

By A. Gwaikokuijin

The export of machinery and machine tools from Japan for the year ending December, 1907, was a record breaker for the country. The total amount exported reached $48,400; an increase of 62 per cent. over the preceding year, and nearly 250 per cent. over the average of the past five years. The bulk of the machinery exported was cotton gins and printing machines which go to China. However, the Japanese manufacturers are now turning out various other kinds, such as automatic machinery for the manufacture of clocks and watches, boilers, drill presses, electric motors and dynamos, gas and oil engines, lathes of English and American types, looms (hand and power), planers and shapers, printing presses, sugar machinery, tea-firing machines and weighing machinery. They are also doing considerable work in such lines as the manufacture of clocks and watches, chemical and physical intruments, drawing instruments, surveying instruments, steam indicators and surgical instruments.

Many, if not all the different lines manufactured here, appear at first sight to be copies, more or less accurate, of similar machines made in the West. Take for instance power looms (with the exception of the Toyoda's patent) they seem to be clumsy imitations of the old-style English hand looms. The Toyoda's patent shuttle, however, is considered to far surpass either the English or American makes owing to the fact of its special design and construction, which enables it to use to advantage the poor warp to be found here and in China. The Toyoda's looms are patented in Japan, China, England, America and some two or three other countries on the continent.

The surveying instrument works, mentioned in the foregoing list of manufactures, makes an instrument that, as a whole, cannot be claimed by any one country as an imitation of its special make of instrument. Its construction consists of three different designs; namely, American, English and Swiss, combined to be best adapted for use in this field. The largest and best plant of this kind here is that of the Tamaya Scientific Instrument Works, Tokyo, which has recently put up a new plant especially designed for the manufacture of this class of work. When the full equipment is installed (mostly of American make) it will have an equipment costing in the neighborhood of $45,000. Here are special dormitories

and baths for the workmen and apprentices, in addition to a free night school for the apprentices.

Machine-tool Building

What is probably the best known builder of machine tools in the country is the Ikegal Iron Works Company, Tokyo. Until the past two or three years one would have very little trouble in telling from about what make of machine their work was copied. However, in the past two years quite a change has been made. Though still holding to the old patterns that have been their best sellers there are many changes in their tools in order to make them better adapted for the work they are to do, and also that they may be more convenient for Japanese workmen.

This plant was first started by the president of the present company some 20 years ago. At the start the only equipment its owners could boast of was a cheap foot-power lathe of American make, installed in a little room about 4x6 feet in size. In a short time it was found necessary to hire a boy to kick the treadle, and from that time on the work has kept increasing.

At the present day there are some 200 men employed, and on my last visit they were working 12 hours per day and yet could not keep ahead of orders; in fact, the manager gave the information that they had orders booked over a year in advance.

To one not well advised in the machine line practically all machines of Japanese make would look no different to them than similar machines they had seen in other countries, however, if one has any knowledge whatever of the manufacture of machines and machine tools, he must, after careful comparison, acknowledge that the Japanese are often very clever in thinking out and designing (inventing if we believe with Entropy) labor-saving devices. A number of such cases have recently been brought to my notice; only one, however, that of the Toyoda's Loom Works, Ltd., of Nagoya, had anything like a cost system whereby they could show the actual labor cost of the various parts which went to make up their machines. Though you could see that there should be a saving in cost by the new methods, no actual figures were to be had. In case of the Toyoda's Loom Works, it was found that they had a system whereby they could tell, not only the cost of one complete part, but the actual time to a minute that it would take to set up for use any of their fixtures for any given operation as well as the time required to do the several operations. The cost of all tools and fixtures used for the work was well known; furthermore they had full data as to cutting speeds and feeds for each operation.

About a year ago the Toyoda's company started to put in an up-to-date equipment; not all at once, but gradually. For instance, as soon as they had put in one or two new machines and had proved to the directors without a doubt that new methods were the best, other machines were installed; at the same time they installed a tool-room system which takes care of the making of all new tools and fixtures, also a tool-distributing room. I understand that this company is to lay out tools and fixtures and use the interchangeable system in the manufacture of all of their different types of looms, consisting of some five in number.

At the Seikosha Watch and Clock Works, Tokyo, are to be found a number of special semi-automatic machines designed by their engineer, and made in the works. In the Violin Works at Nagoya, where some 7000 instruments are manufactured annually, ranging in price from $1.50 to $75 each, there are to be found a number of simple machines invented and made by the engineer and his workmen. The tea-firing machinery used in this country and a large part of that used at present in China is admittedly of Japanese invention.

Osaka, Japan.

It is interesting to note from a paper read before the Institute of Naval Architects that on a voyage of 2781 miles from Queenstown to New York the recently built turbine-driven steamer "Lusitania" had a daily coal consumption of 1090 tons, which comes within 10 tons of the estimated coal consumption made by the designers while the ship was building.

The Artisan Speed Lathe

Editorial Correspondence

Fig. 1 shows the speed lathe built at the Artisan school which has in connection with the countershaft enough novelty to make it of interest to those interested in lathes and countershafts. The most novel feature about the lathe is the section of the bed, Fig. 2, and the method of guiding and holding the tailstock and hand rest. The entire guiding surfaces are the side V's, which are effectually protected from dirt, chips and bruises. The binding bolt in the center of the tailstock makes it secure by simply pinching the sides together. The second feature is the stationary flanges to the cone.

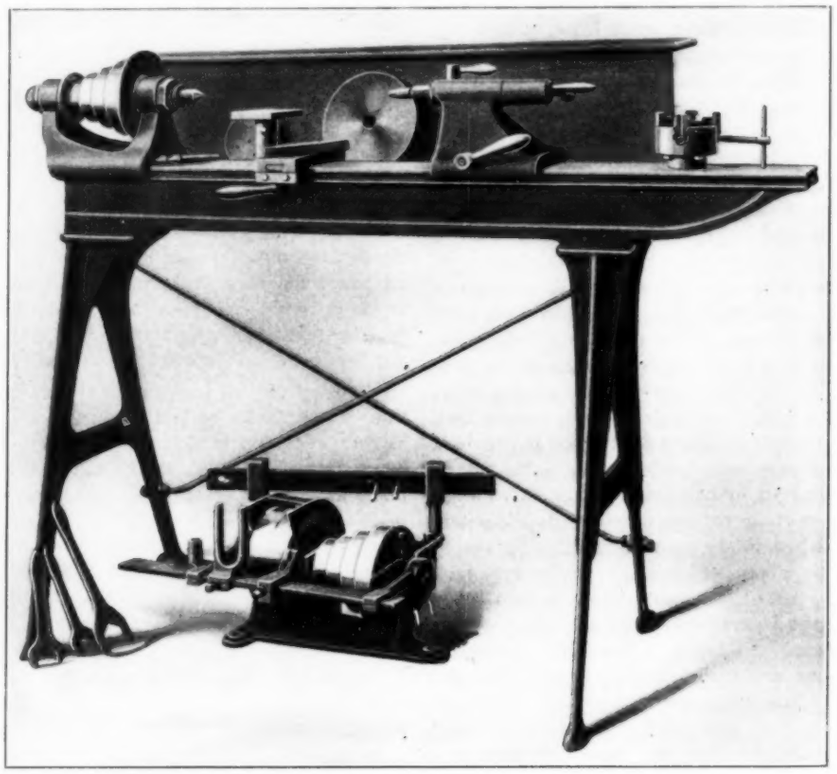


FIG. 1. THE ARTISAN LATHE

The journals of the shaft are parallel and have oil rings; the boxes are held in conical seats, split to permit of taking up wear, with nuts outside and in; the two inside nuts are integral with the cone flanges. The nose of the spindle has a coarse thread on the outside of the collar (on the plan of the Pratt & Whitney lathe) and there is a ball-thrust bearing in the small end of the cone.

Fig. 3 shows a center for wood turning which is furnished with the lathe. As the center point and driving spurs *A A* tend to split the wood, the two bevel lips *B B* tend to bind the wood together. It is simple to make and works well.

The lathes are supplied with chucks, face-plates, centers for wood and iron,

hand rests, tool rack, drawers, etc. The legs at the tailstock end are pivoted to the bed, giving the bed three points of support.

The countershaft rig probably comes as near being complete as any yet produced where only a single belt is used. There

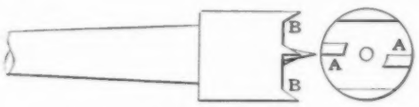


FIG. 3. CENTER FOR WOOD LATHE

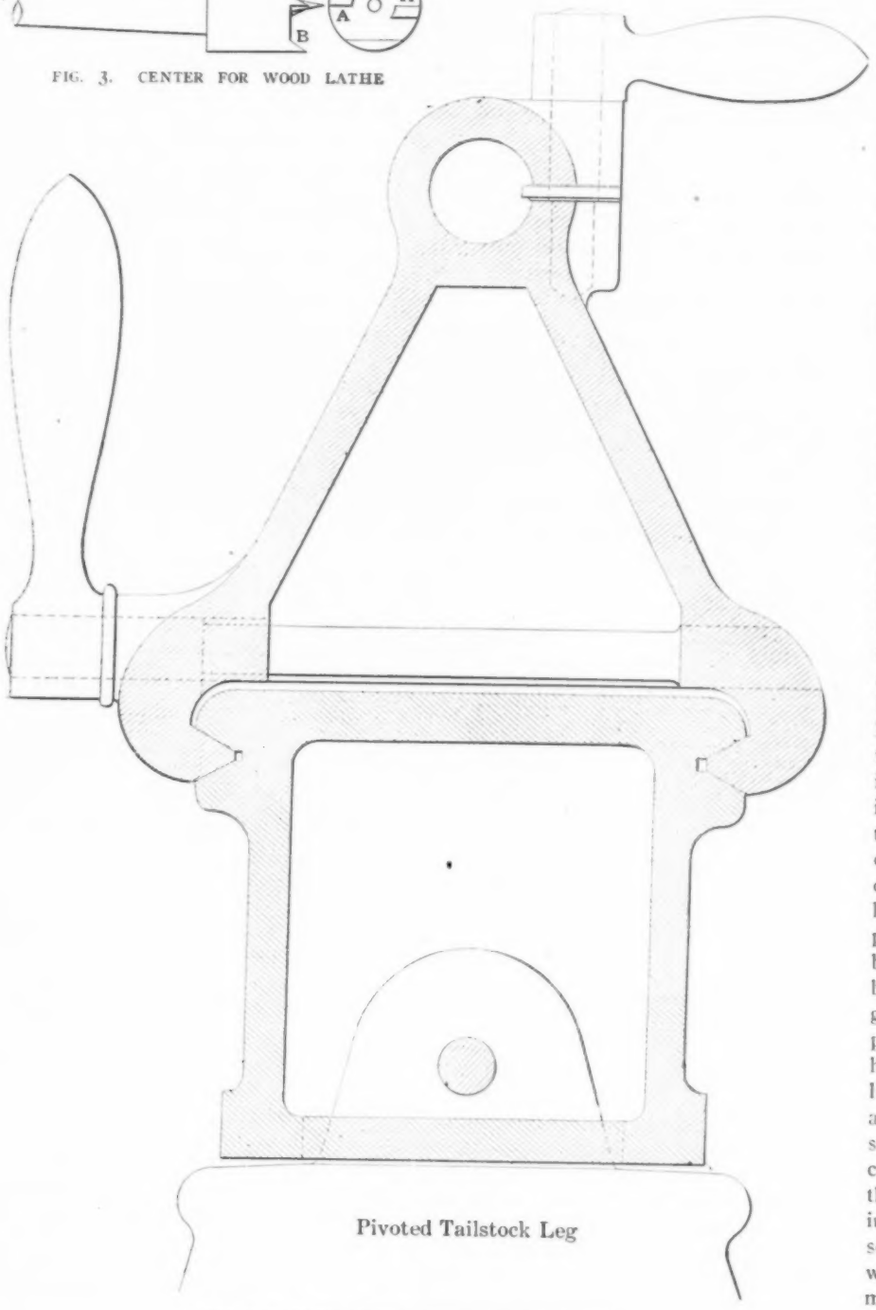


FIG. 2. SECTION THROUGH BED AND TAILSTOCK

is a plate with the two hangers and two stationary flanges cast with it to keep the cone belt on, and this is bolted up to the overhead plank or timbers by three bolts only; two bolts to take the pull of the line shaft and one to take the pull of the cone belt. Bolted to the plate is a cage which is reversible as are the brackets that carry the main belt shipper, permitting the belt to come from either front or rear. This effectually prevents the line-shaft belt getting off the pulleys. The main belt shipper is operated by a short crank on the upper end, and a handle at the lower end of a rod. The short crank ending its travel about on its dead center locks the shipper bar in both positions, and when the belt is thrown on the loose pulley it puts a brake on the tight pulley and stops the lathe. A gas pipe outside the above mentioned vertical rod with a handle at the bottom and an arm at the top shifts the cone-shifting bar which is set at the proper angle to shift the belt on the cone. The countershaft itself is stationary, the tight pulley is fast to the cone, the loose pulley runs on a sleeve, and the whole runs on and is oiled through holes in the ends and bottom of the shaft which introduces (as it should) the oil at the slack side of the bearing. Oiling through the middle of a stationary shaft permits of oiling at any time, whether the pulleys are running or at rest. The oil holes are protected from the gathering of dirt, and twenty-five years' use of the lathe, illustrated and described by Professor King in the AMERICAN MACHINIST in May, 1889, has proved it a good plan.

The lathe is 10-inch swing, 4-foot bed with a 12-inch removable extension, and the large face-plate and flat rest is to use sandpaper for squaring up wood, as is done with metal on a Gardner grinder.

Helium Gas Heavier than Liquid

The idea of a liquid that is heavier than a solid is not hard to grasp, for we are all accustomed to seeing solids floating on water, and even metals will float in mercury. That a gas should be heavier than a liquid, however, so that a bubble of it would fall instead of rising in the liquid, is hard to realize. This is the case with helium gas under pressure in liquid hydrogen, as demonstrated recently in Germany. Says a writer in *Cosmos*: "We are used to thinking of gases as always less dense than liquids, and, in fact we have never hitherto been able to increase the density of a gas, either by compressing or by cooling, down to the point where it becomes heavier than a liquid in contact with it. This could not take place, of course, if the gas became liquid or dissolved in the liquid. Dr. Kammerliugh Onnes has, nevertheless, accomplished this surprising feat by causing a bubble of compressed helium to descend by its own weight through liquid hydrogen, like a drop of water in oil. He compressed a mixture of hydrogen and helium in a capillary tube plunged into liquid hydrogen. The hydrogen becomes almost entirely liquefied and, if the pressure does not exceed 49 atmospheres, occupies the bottom of the tube. Beyond this pressure a bubble of almost pure helium, which is floating on the liquid, is seen to descend below it, and to rise again when the pressure is decreased to 32 atmospheres. * * * Besides its originality, this experiment will enable us to ascertain * * * the limit density of helium, which Van der Waals supposes to be that of the heavy metals."

Aside from the highly interesting results to be obtained from experiments with this unique form of gas, it is to be expected that some important useful information will be derived from experiments with helium gas, as has been demonstrated by the original experiment.

Internal Cutting Tools for Screw Machines*

Spotting and Facing Tools Are Used for Starting Holes Which Are Completed by Drills, Reamers and Counterbores of Various Types

BY C. L. GOODRICH† AND F. A. STANLEY‡

The design of internal cutting tools is largely governed by the character of the material to cut, the depth of hole, and in tools for finishing, the amount of material left by the roughing tool for removal.

As with external cutting tools the clearance and rake of the cutting edges, the number of cutting edges, and the means of avoiding accumulation of chips must be considered in connection with the nature of the material to be cut.

Starting Drills

It is generally advisable before attempting to drill a long hole to use what is termed a starting drill, which tool is usually either of the flat type, as shown in Fig. 1, or, somewhat similar to a twist drill, only having short flutes like Fig. 2. The point should be quite thin and the lip angles more acute than the drill that is to follow, as in this event the outer diameter of the drill is permitted to cut before its blunt non-cutting center web comes in contact with the work. Fig. 3 illustrates a twist drill entering a piece of work that has previously been spotted with a starting drill, and the twist drill will be found to run true under these conditions. When the blunt center web of a drill is allowed to come in contact with the work first, as in Fig. 4, the value of the starting drill is not nearly as great as under the conditions in Fig. 3. For starting drills under ¼ inch in diameter the flat starting tool, Fig. 1, is very satisfactory, while for larger work, except brass and similar materials, the type illustrated by Fig. 2 is more commonly used.

Spotting and Facing Tools

On long, slender work made of smooth stock close to size and which projects a distance from the head spindle it is generally found necessary to support the end of the work close to the point being spotted, and in such cases the starting or spotting drill is held in a holder which is also suitable for guiding the outer end of the work. Fig. 5 illustrates a tool of this type.

In some cases combination spotting and end-facing tools like Fig. 6 are used. This type of tool is very satisfactory on brass work, etc., but on harder materials, such as steel, which is more destructive to the cutting edges and thus makes frequent regrinding necessary, a tool holder having separate starting and facing cutters, as shown in Fig. 7, is preferable, as the independent adjustments allow frequent sharpening to be more economically accomplished.

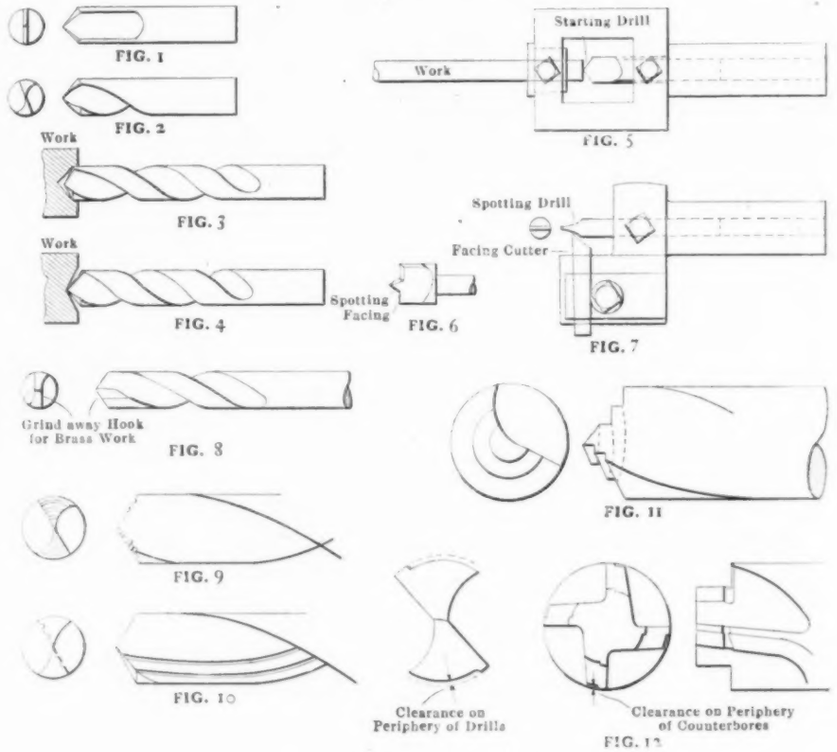
Twist and Straight Flute Drills

In drilling cylindrical holes standard commercial tools are preferred owing to the convenience of replacement when they become worn out or broken. Ordinary twist drills are very satisfactory in steel and cast iron, although in very deep holes the chips are sometimes difficult to get rid of, and clogging up of the flutes and occasional breakage will then occur unless frequent withdrawing of the drill is resorted to. On brass and all free cutting stock the rake given to the cutting edges of twist drills generally causes excessive curl to the chips and thus makes the automatic removal of the chips from the hole difficult. On automatic screw machines oftentimes a long curled chip is very objectionable as some machine functions may be interfered with. For these reasons when twist drills are used in brass, it is good practice to reduce this rake by grinding in the lips at the front end, as in Fig. 8.

A two-lip, straight-fluted drill commonly known as a "Farmer" drill is generally superior to the twist drill in cases where the curling of the chips is troublesome, and in shops where brass work predominates this drill is used much more commonly than the twist drill.

Serrated, Fluted and Stepped Lips

The cutting edges of drills are sometimes serrated as indicated in Fig. 9 to produce narrower chips than would otherwise result and so facilitate their easy removal. A similar effect is produced by fluting the drill, as shown by Fig. 10. Still another method of producing narrow chips is to step the end of the drill. It may be of interest to mention that this latter scheme is very commonly used in the one-lip drills for drilling long holes in gun barrels, spindles, etc. Fig. 11 will give an idea of this type of tool. When such a drill is carefully guided and advanced at a low rate of feed it is possible to drill a distance of 30 or 40 inches with not more than 0.010 inch curvature in the length of the hole. There is no center



SPOTTING TOOLS AND DRILLS

*Copyrighted, 1908, by Hill Publishing Company.

‡Department foreman, Pratt & Whitney Company.

†Associate editor, American Machinist.

web to prevent free cutting as in the two-lip twist drill, and oil is forced under pressure to keep the cutting cool and conduct away chips. The use of oil in this manner is found very effective with all classes of internal cutting tools, except when operating in cast iron. It makes possible the running of work at a high peripheral speed without excessive heat, results in rapid cutting and insures long life to the cutting edges of the tools.

The center edge of all twist- and straight-flute drills should be thinned down at the cutting point, as the drill will then cut more freely and less power be required for the work.

Back and Land Clearances

Drills should have some back clearance, from 0.007 to 0.015 inch per foot being common practice. The land back of the cutting edge should be quite narrow as little land is required to support the drill and prevent chattering, while an excessive width increases friction and heat, resulting in the welding of chips to the drill along these surfaces and the consequent production of rough holes of varying diameter. Fig. 12 represents the manner in which drills and counterbores should be cleared on their peripheries.

The milling cutters used to flute twist and other drills should be of such form as to produce a straight cutting edge on the drill. If there is a curve to the cutting edge curved chips are produced which are difficult to bend or curl and such chips not only cause excessive heat, but severe strain on the cutting tool and frequent breakage of the latter.

The various steps on short internal cylindrical cutting tools should be tapered back about 0.020 inch per foot, and the peripheral contact reduced to a minimum so as to give ample chip clearance and avoid welding of chips.

Flat Drills and Counterbores

Fig. 13 illustrates a type of tool commonly termed a flat drill, which is extensively used on brass work; it is especially recommended for such material where there are numerous shoulders or forms to be cut out. The tool has a cylindrical shank which fits a turret tool holder. On large work it is customary to make the flat drill of rectangular stock and utilize a special holder, as shown in Fig. 14.

Such tools when held in the turret, as in Fig. 15 should be placed with the faces vertical so as to prevent them from cutting appreciably oversize if the indexing of the turret, due to wear, is not perfect. In the event of the turret holes after long usage being badly out of line, an adjustable holder should be used. A tool of this character is illustrated in Fig. 16.

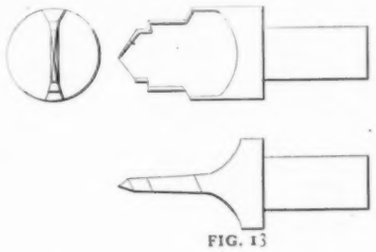


FIG. 13

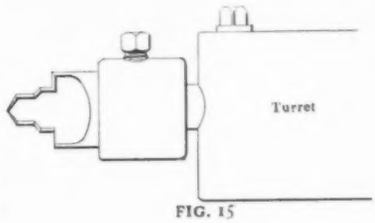


FIG. 15

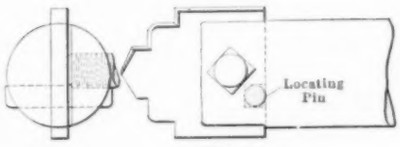


FIG. 14

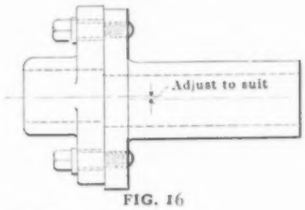


FIG. 16

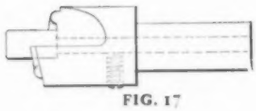


FIG. 17

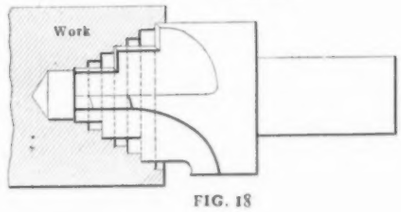


FIG. 18

FLAT DRILLS AND COUNTERBORES

A one-lip drill or counterbore with a helical cut as represented in Fig. 17 is found superior in many cases as it permits of grinding the cutting edge without changing the form of the hole produced.

Counterbores as well as drills should have sufficient back and peripheral clearance but should not have too many cutting lips. A back clearance of about 0.020 inch per foot is satisfactory. For counterbores up to 1 inch three flutes or cutting lips are ample; more flutes are apt to result in insufficient chip space.

Stepped Counterbores

In making stepped counterbores where chips bother, it is conducive to good results to provide only one cutting edge for each step and to have successive cutting edges arranged spirally on adjacent cutting lips. Fig. 18 illustrates a stepped counterbore for roughing a hole that is afterward to be finished by a taper reamer. The advantage of this stepped counterbore lies in its producing a hole with a number of slight steps without an undesirable quantity of chips to wedge and cause trouble. For brass work the flutes of counterbores should generally be parallel with the body of the tool, while on steel the flutes should be cut so as to give a positive rake angle of 10 to 15 degrees; the deeper the hole to be counterbored the less the angle of the tool. For steels and particularly in deep holes, internally lubricated counterbores are effective in keeping the edges cool and in forcing out chips. The various effects produced by counterbores with their cutting edges ahead or behind center, the value of proper rake, and lubricants were discussed in the article on clinging of chips to screw-machine tools, at page 112, Vol. 30, Part 2.

Machine Reamers

Machine reamers are generally used for finishing holes smoothly and to size and consequently it is advisable not to leave too much stock for these tools to remove. On steel work from ⅜ to 1 inch in diameter, from 0.004 to 0.008 inch is generally satisfactory, while in brass from 0.006 to 0.012 is a suitable amount. It is well to have the teeth of all reamers unevenly spaced as there is then less liability of chattering than where even spacing is adopted.

Cylindrical reamers should only cut on the front end in entering a hole; they cut back of the front end, on the lips, only when the material being reamed alternately expands and contracts through undue pressure or variation in temperature produced by the cutting action. This latter is particularly noticeable in brass tubing. Most cylindrical reaming tools like Fig. 19 are cleared the entire length of their cutting lips as well as having a back taper of about 0.004 inch per foot. For reaming steel where it is desired to produce an accurate smooth hole the so-termed rose reamer, Fig. 20, is excellent. This tool can cut only on the front end and must be well lubricated and not forced so as to expand the work. It will ream holes under these conditions that are satisfactory to the most exacting. For this work a rose reamer is better than a reamer with peripheral clearance, as its weight is more satisfactorily supported and there is thus more certainty of a round hole being reamed. A rose reamer, as intimated, has no peripheral clearance on the flutes but should be back-tapered about 0.004 inch per foot.

The Cutting Edges

The cutting edges of reamers are seldom undercut and are generally on center, although for brass it is considered by many advisable to mill the cutting edge

ahead of center and so secure a scraping cut. The flutes are generally milled parallel with the body of the reamer, but in many cases a spiral-fluted reamer has been the means of obviating chattering.

The spiral should be cut left-hand to prevent drawing in. In small work, particularly brass, a flat reamer like Fig. 21 gives good results. It is inexpensive to make and may be readily resharpened as indicated.

Reamers, or more correctly, boring tools with three flutes and with only one cutting edge as shown by Fig. 22 are found very useful for producing straight, deep holes.

Number of Flutes in Reamers

The number of flutes cut in ordinary reamers should be as indicated by the following table:

Hand.	Fluted Chucking.
⅛ to 3/32 dia. 4 flutes.	1/16 to 7/128 dia. 6 flutes.
¼ to 15/64 dia. 6 flutes.	3/32 to 1¼ dia. 8 flutes.
½ to 1¼ dia. 8 flutes.	1 5/16 to 1 1/4 dia. 10 flutes.
1 9/32 to 1 13/32 dia. 10 flutes.	1¾ to 2 7/16 dia. 12 flutes.
1 3/4 to 2 7/32 dia. 12 flutes.	2¼ to 2¾ dia. 14 flutes.
2¼ to 2¾ dia. 14 flutes.	2 1/16 to 3 dia. 16 flutes.
2 19/32 to 3 dia. 16 flutes.	

Reamer Holders

Usually reamers for cylindrical holes (and sometimes finish counterboring tools) are carried in holders permitting of a floating action of the reamer. When a reamer is held rigidly in the turret hole there is almost a certainty of its cutting an oversize and tapering hole due to the impracticability of retaining the turret hole in perfect alinement with the work spindle. There are a variety of floating reamer holders used. A simple form is illustrated in Fig. 23. With a reamer held in a suitable floating holder and providing the end of the hole that is to be reamed, has been bored out so as to run true, and from 0.003 to 0.015 undersize, there should be produced a hole true to size and concentric.

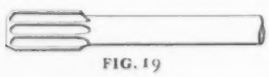


FIG. 19

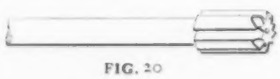


FIG. 20

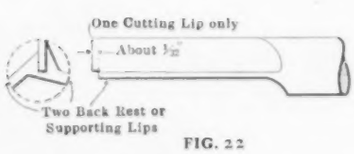


FIG. 22

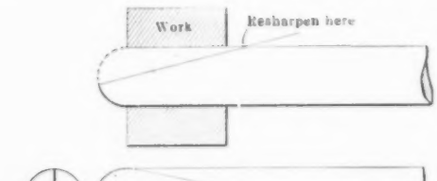


FIG. 21

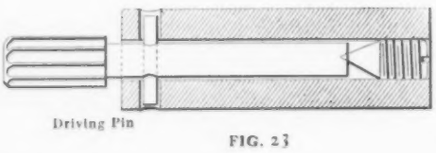


FIG. 23

REAMER AND HOLDER

Taper or formed reamers should be provided with clearance the entire length of their cutting lips. The lips or lands instead of being continuous are in the case of long reamers usually serrated by means of a narrow left-hand spiral groove and this breaks up the chip into a number of curled strips instead of producing a single wide one. The flutes in taper reamers are sometimes milled left-hand so as to prevent pulling in, and sometimes right-hand to assist in cutting. On slight tapers any tendency to draw in must be obviated owing to the risk of breaking the tool, while on steep tapers which resist the feeding in of a tool an opposite effect is desired.

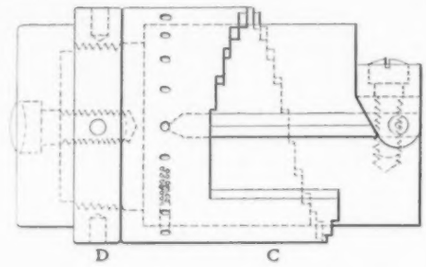
In practice, therefore, it is found satisfactory from the cutting point of view, to make the flutes left-hand in reamers producing holes tapering from 0 to about 1½ inch per foot. From 1½ to 2¼ inches taper per foot the flutes may be straight, while on tapers greater than this a right-hand flute is satisfactory. This latter gives a positive rake to the cutting edge and less end pressure is required to force the tool to the cut than with straight or left-hand flutes.

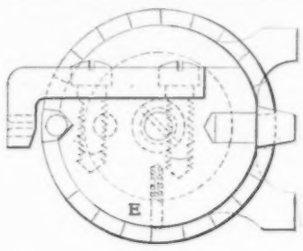
The cost of making tools with right- or left-hand flutes is somewhat greater than for straight flutes, and grinding is not so readily accomplished with ordinary equipment, hence straight-flute taper reamers are more commonly used.

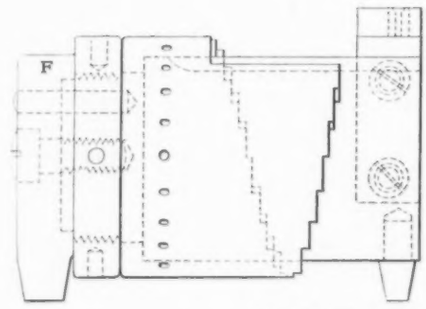
A Jig for Drilling Crosswise Holes

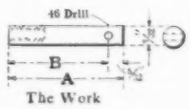
By T. O. Loomer

There are many forms of V-block drill jigs in use for drilling cross-holes in round-bar stock, but I believe the accompanying illustration shows something new in this line.









JIG FOR DRILLING CROSSWISE HOLES

The work to be drilled was cut off in the screw machine from ¼-inch rod, and the end hole tapped and faced. There were 20 lengths of these pieces, ranging from ¾ to 2 3/16 inches. Dimension *A* varying considerably, it was decided to gage from the tapped end as dimension *B* must be quite accurate.

The body of the jig was made from round machine steel, turned to receive the hardened and ground barrel *C*. This barrel was bored to a shoulder and the steps milled for the different lengths. It is held in place by lock nut *D*. The different steps are numbered to correspond with the work, and a small spring plunger at *E* holds the barrel in its proper position. The body is turned down at *F* to receive the end piece and the feet. This piece is fastened with one screw, and has a dowel to keep it in alinement. The third foot of the jig is shown at the front.

The production of pig iron in the first half of 1908 was 6,918,004 gross tons, against 12,303,317 tons in the last half of 1907 and 13,478,044 tons in the first half of 1907.

A Test Indicator and Some of Its Applications

A Sensitive Instrument Which Can Be Employed for Setting and Testing Lathe, Miller, Shaper and Surface Plate Work

SPECIAL CORRESPONDENCE

In Figs. 1 and 2 is illustrated a new test indicator in which are incorporated some interesting features. The indicator proper consists of a rectangular steel case which carries the pointer, lever, and other mechanism and is adapted to swivel freely at the end of a holder which may be used in the lathe, shaper, or miller. The indicator head may also be attached to the post of a surface gage and used for a variety of bench-plate work, or it may be placed on either of its flat sides and operated in conjunction with size blocks and parallels for testing work. The contact point for external and internal operations are at opposite ends of the indicator and by loosening the clamp nut underneath the device is readily swiveled end for end to bring either point desired into contact with the work.

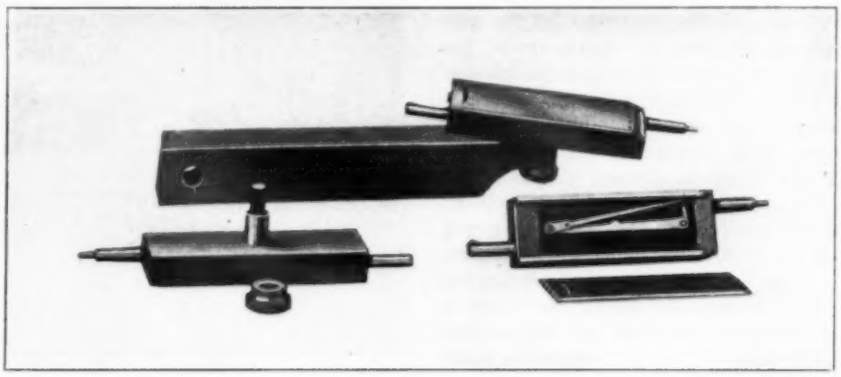


FIG. 2. TOP AND BOTTOM VIEWS OF TEST INDICATOR

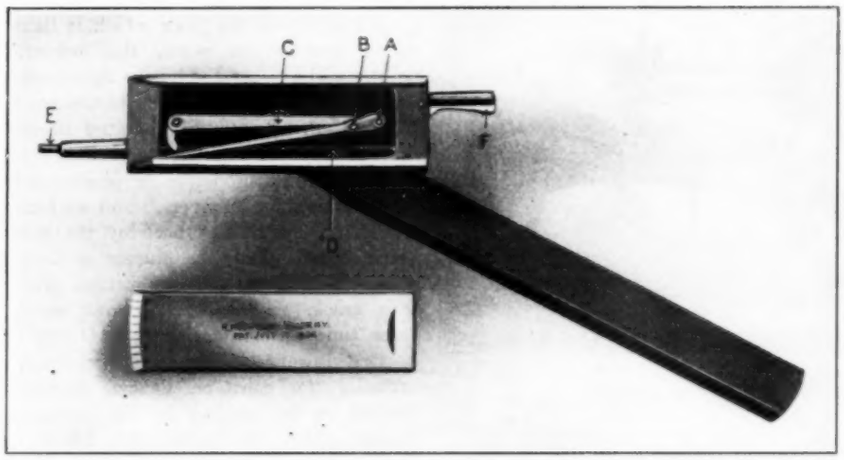


FIG. 1. TEST INDICATOR WITH COVER PLATE REMOVED

Adjustment on Holder

It will be seen that the indicator may be swung around and clamped at any desired angle on the holder or shank, and, as there is a hole drilled crosswise through the latter at the rear end, the device may be attached at the side of the shank and then swiveled to any position required. This feature is of advantage especially when the instrument is to be clamped between collars on a milling-machine arbor, as the holder may then be placed with its broad, flat side against the arbor and with the narrower edges gripped securely between the collars at either side.

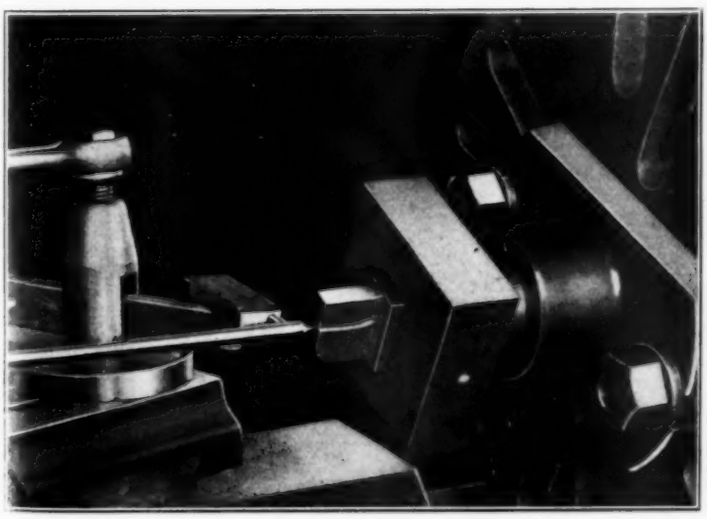


FIG. 3

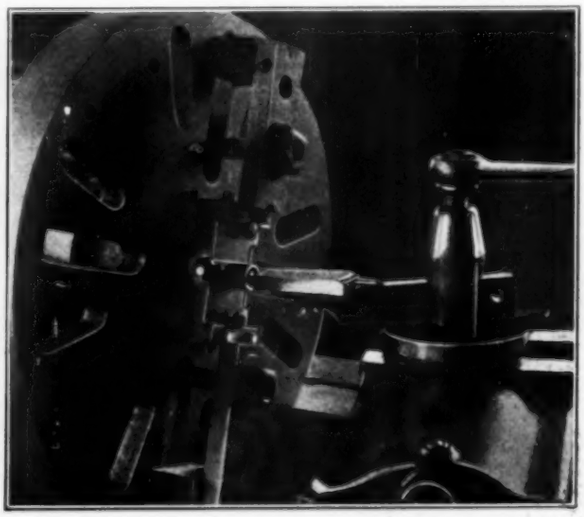


FIG. 4

THE INDICATOR IN THE LATHE

The indicator thus constitutes a universal device whose numerous applications are but briefly outlined in this article. The illustrations, Figs. 3 to 9, showing some of its uses will, of course, suggest many other ways in which it can be employed to advantage by the toolmaker.

The Mechanism

The indicator mechanism, which is simple, light and well protected by the rectangular case and its sliding cover (on the beveled end of which are graduations reading to thousandths) may be briefly described as follows: The indicating pointer is pivoted at *A*, Fig. 1, and has a pin at *B*, which contacts with the edge of the long arm of rocker lever *C*. Against pin *B* rests the end of a spring coiled about the post under *A* and tending to swing the outer end of the indicating pointer across the opening in which it plays when in operation, or to a position directly opposite that in which it is actually shown in the engraving. When the instrument is at rest, however, the pointer is maintained in the position shown by plunger *D*, which is pressed forward by the compression spring shown, and a collar on which contacts with the short arm of lever *C*.

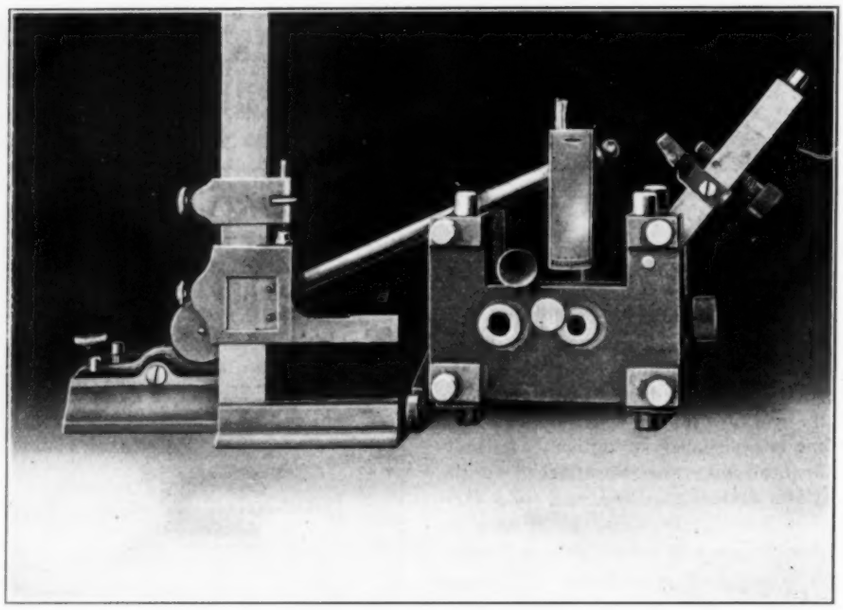


FIG. 9. MAKING A MEASUREMENT IN A JIG

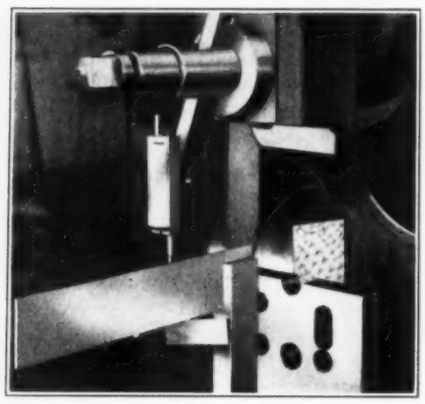


FIG. 7. SETTING AN ANGLE IRON IN THE SHAPER

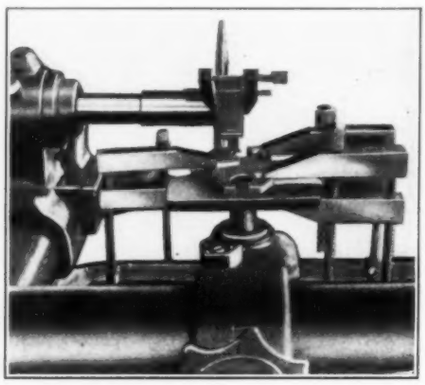


FIG. 8. SETTING A SNAP GAGE FOR GRINDING

Control of Pointer

The outer end of the plunger forms the contact point *E* for external work; and it is obvious that when it is pressed back by the action of the piece which is being tested against the point, the indicator pointer will be operated by the light spring under *A* to show any errors in the work. That is, the pointer is actuated in one direction by the light spring referred to, but the spring can operate the pointer only when the contact plunger *D* and its heavier spring are pressed back by the work being tested. Thus the pointer is always controlled between the two springs, giving it a quick, sensitive action, and at the same time the contact plunger *D* can be pressed inward to its limit without increasing the constant, delicate pressure applied to the pointer by the operating spring coiled about pin *A*. There is, therefore, no possibility of the instrument being injured if brought against the work too abruptly, or with too great pressure.

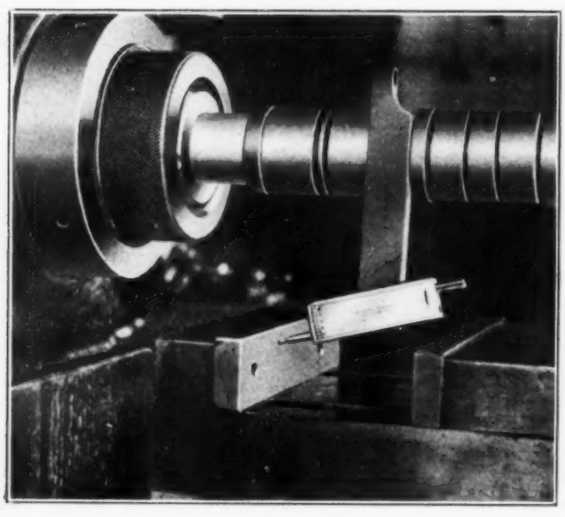


FIG. 5

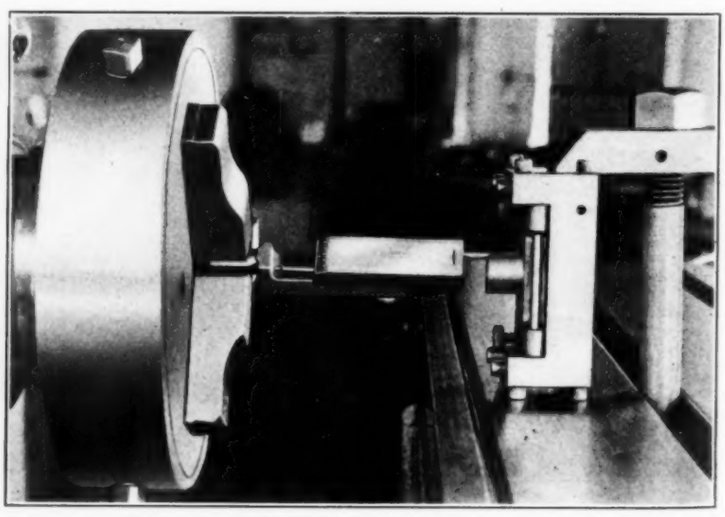


FIG. 6

THE INDICATOR IN THE MILLER

Application to Internal Work

Internal indicating, as well as some external testing operations are accomplished by the contact piece *F* which is in the form of a bell crank with the concealed end abutting against the inner face of a collar at the rear end of plunger *D*. When this end of the instrument is in use the action of the mechanism is precisely the same as when the end *E* is employed. In one case the spring plunger *D* is drawn back from the rear; in the other it is pushed back from the front.

Lathe Operations

In Figs. 3 and 4 are shown two applications of this indicator to lathe work which has to be trued up prior to machining. The first illustration represents a method of centering a pilot in a punch which is held in a special face-plate fixture.

The illustration in Fig. 4 shows a method of locating a jig on the face plate prior to boring a bushing hole; the indicator in this case is brought into contact with a button which is located at the desired point on the jig leaf.

The Indicator as Used on the Miller

Fig. 5 illustrates the manner in which the indicator may be clamped to the milling-machine arbor while testing a vise jaw to determine if the vise is properly set. Fig. 6 shows the indicator held in a chuck on the miller spindle while a jig on the table is being located by means of a button on which the indicator contact point rides.

Shaper and Other Applications

In Fig. 7 is represented a method of testing an angle plate set up in the shaper. A standard square is clamped to the plate and the indicator is held in the tool post. The ram is operated to traverse the indicator along the blade of the square and thus any error in the work may be readily detected.

Fig. 8 shows how a snap gage may be located for grinding out the jaws, and Fig. 9 illustrates a surface-plate job where it is desired to transfer a measurement from a hight gage to a surface inside a jig which it is difficult to reach by ordinary means. The indicator in this instance is attached to a surface gage and extends down inside the jig in a perpendicular position, as illustrated.

The indicator is manufactured by Henry Koch & Son, Nyack, N. Y.

Finished Stock and Chip Separator

By M. E. Service

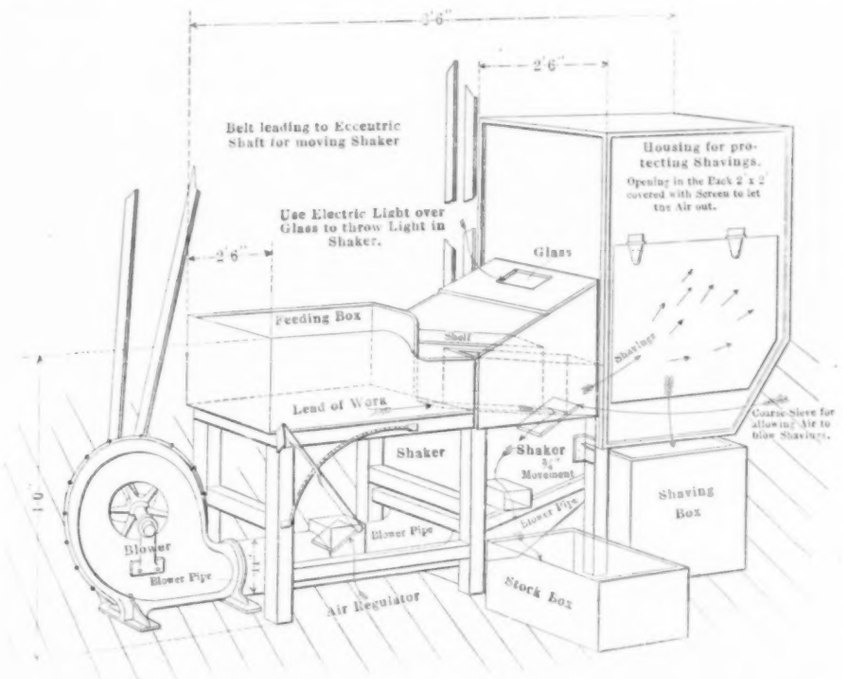
In screw-machine work it is customary, generally, to allow the finished stock as made by the machine to drop down, together with the oil and cuttings into a cast pan of the machine. The greater part of the oil can, of course, be drained off, strained and pumped up to the work again, but your finished stock will be mixed up with the chips and will have to be separated.

The drawing herewith shows a separator which was made about three years ago by the National Cash Register Company, for its own use only, and is not made for sale. The chips, with the finished stock of one kind mixed through them, are shoveled from the catch pans of the screw machines into large, round, galvanized buckets about 16x20 inches. These buckets are trucked to a side room containing a centrifugal oil separator, into the pan of which one of these buckets of shavings and finished stock is dumped. This pan is elevated into the bowl of the oil separator by a simple air hoist, after which the shavings and finished stock are dumped into the feed box of the stock and chip separator shown herewith. A workman with a paddle then pushes the shavings and finished stock in the direction as shown by the "lead of work" arrow, on to the inclined top of a shaking box, marked "shaker."

Owing to the shaking motion the finished stock and chips slide down this inclined top of the shaker box until they come to the edge, when a blast of air, leading from a No. 4 Sturtevant blower and entering the shaking box, blows the comparatively light chips into the large box at the back end of the separator, where they strike and drop to the shaving box below. The finished stock, nice and clean, drops on to the second incline, which leads the pieces through a tube within the shaking box, and they fall from this tube into the stock box as shown.

The blower pipe has an air regulator governing the force of air necessary for light or heavy finished stock. The shaking box is hung on four bearings and moved sideways by two eccentrics driven by the belt as shown, and an electric lamp throws light onto the separating point so that the operator can see when the force of air is correctly adjusted.

Nearly everything is made of wood, protected in places with tin sheeting, and the principal dimensions are given. It works well and should particularly appeal to manufacturing concerns having large quantities of stock to separate. With a screw-machine department having 375 machines of all kinds, 341 of which are automatic screw machines, it would require not less than 20 boys at 10c. per hour to separate the work, using sieves as generally practiced. But with a simple machine of this nature and with two men only to operate both oil separator and stock and shaving separator you will obtain perfectly clean finished stock, for less money and less bother.



FINISHED STOCK AND SHAVING SEPARATOR

Every now and then the question of a suitable substitute for wooden cross-ties is brought to attention and so far no material offered except metal seems to come near meeting the requirements. It is interesting to note that on the Pennsylvania Railroad alone 4,000,000 cross-ties are used annually and the difficulty of securing them in sufficient quantities, even at the greatly increased price of recent years, seems to point to the steel tie as the only salvation. Experiments with the steel tie are being carried on by several of the leading railroad systems in the country and successful outcome is looked for before many years.

A Method of Cutting Racks on a Planer

Including Details of the Spacing Mechanism on the Cross-rail and Other Information in Regard to Tools and Clamping of Work

BY HOWARD HUNT

The cutting of racks on the planer requires several jigs and fixtures for spacing the teeth accurately and for holding the different tools and clamping the work in place. It is preferable to have the spacing of the teeth done automatically by power, rather than by hand, because the teeth are likely to be of more uniform thickness and it is also done more quickly.

The rack-cutting attachment used at the shops of the Cincinnati Planer Company, Cincinnati, O., will probably be of interest to many who are interested in rack cutting, it being their aim to overcome most of the aforesaid difficulties. The spacing attachment is placed on the back of the left-hand end of the rail and which can be seen in Fig. 4. The power for driving it is taken from the planer countershaft by means of the belt shown in Fig. 1. The tight and loose pulleys are on the same shaft as the small pinion *A*, which meshes with a large gear on the friction shaft; thus when the belt is on the tight pulley, the train of gears to the rail screw are being driven through the friction, which is adjusted to the required tension by means of the screw and spring as shown at *B*, Fig. 1.

At *D* is a stop, which upon coming in contact with plunger *C* prevents the sleeve *E* from rotating, and as long as the belt is on the tight pulley, it causes the friction to slip. By means of the shifting mechanism and the two links shown, together with a handle for operating these links on the right-hand side of the machine, the belt is left on the tight pulley while the spacing occurs, thus causing a minimum amount of slipping of the friction.

Compound Gear
Showing Method of Fine Adjustment.
FIG. 2

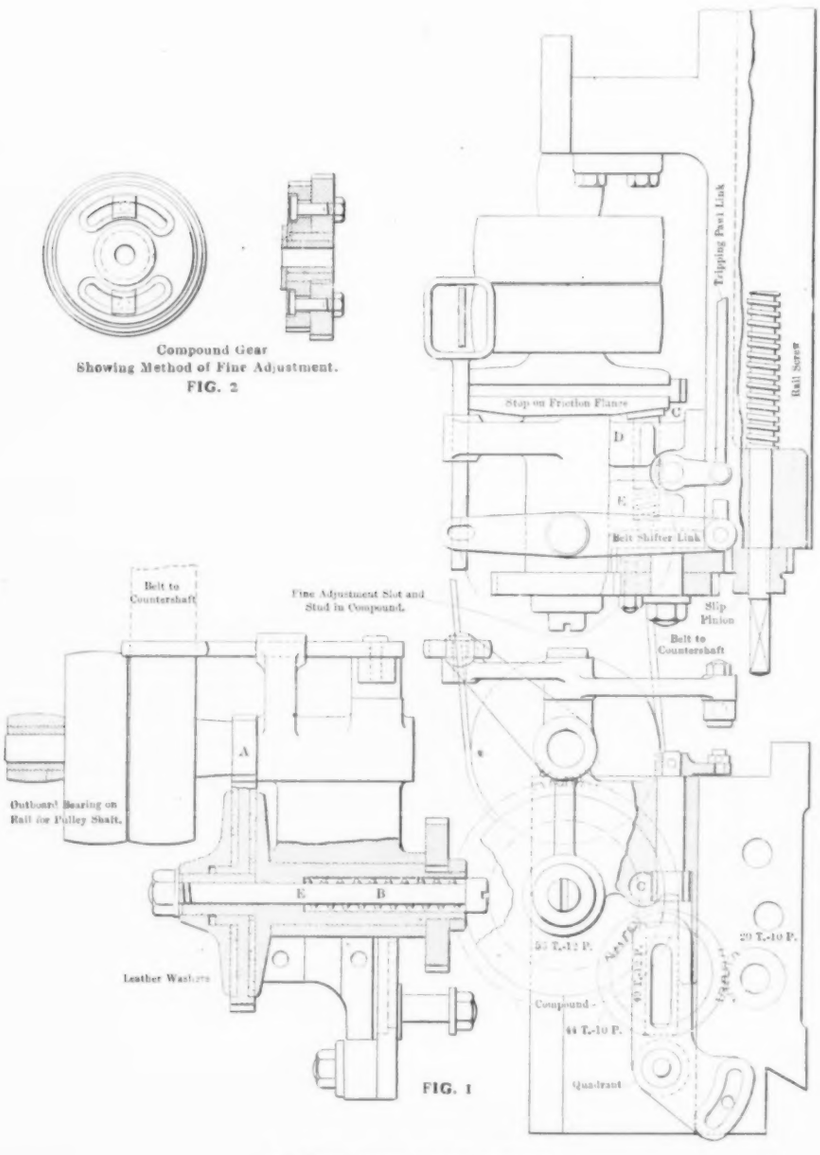
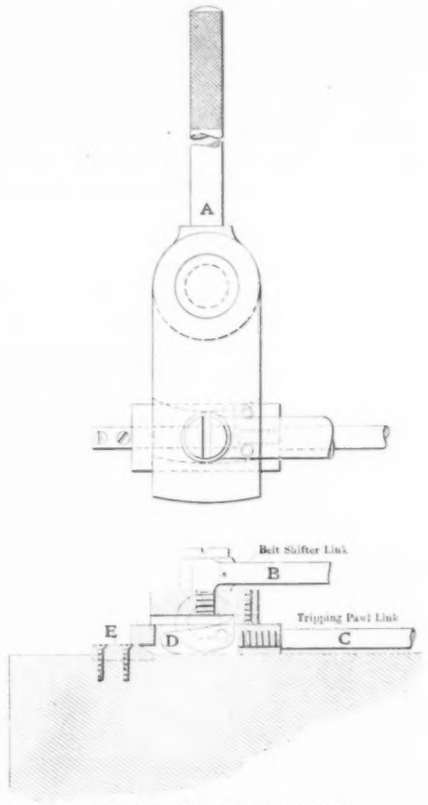


FIG. 1

SPACING MECHANISM DETAILS



Handle on Right Hand End of Rail

FIG. 3. HANDLE OF THE SPACING MECHANISM

In order to use one handle for tripping and shifting the belt, the handle on the right-hand side of the machine is so arranged that the link to the plunger is automatically released when the handle has moved through a sufficient arc to enable the stop *D* to pass the end of plunger *C* and is pulled back into place instantly by means of a spring *E*, so that the stop hits it again upon completing one revolution.

The details of this handle are clearly shown in Fig. 3, and the operation is as follows: Moving handle *A* in the direction of the arrow carries with it the belt-shifting link *B*, which in turn shifts the

belt shown in Fig. 1 from the loose to the tight pulley, causing the gears to rotate. This handle also carries the tripping link *C*, Fig. 3, with it, until trigger *D* strikes the steel plate *E*, when it is released and brought back to its original place by means of the spring acting on the tripping plunger *C*, Fig. 1. Thus it will be seen that the plunger is tripped and the friction and shaft *B* started to move, with the first movement of the handle, but the plunger *C* will have snapped back to its place before the friction has made a complete revolution. Upon handle *A* being brought back to its first position, the belt, of course, moves to the loose pulley again. Then by suitable gearing to the rail screw this one revolution of the sleeve *E* can be made to move the saddle on the rail any desired amount and exactly the same amount every time.

In order to facilitate quick changing of the gears to suit different pitch of rack, a quadrant is mounted on the rail and together with the compound gear shown in Fig. 2, any desired pitch may be quickly arranged for.

The compound gear is clamped together with two bolts, which work in T-slots; by loosening these bolts the rail screw can be turned by means of the crank handle and a much finer adjustment obtained than by the use of the slip gear on the rail.

Plunger *C* and stop *D* are beveled in opposite directions, so that when the friction is reversed by hand the bevel on stop

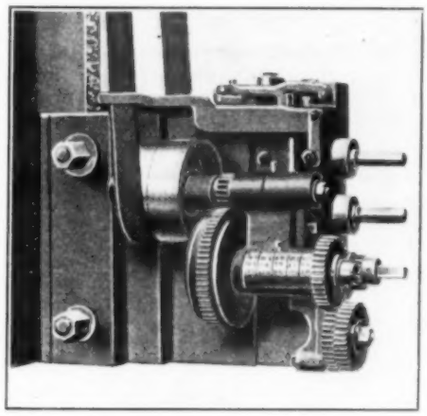


FIG. 4. THE FEED GEARING

D will force the plunger *C* back, allowing the tool to be brought back to any point, without disturbing the gearing.

The roughing is done by three self-hardening cutters shown in place in Fig. 5, the entire tool block with cutters being réplaced for finishing, with a tool block into which a special single-point tool is fitted. This tool is made by the Brown & Sharpe Manufacturing Company, specially to suit the particular size gear meshing into each particular rack. The rack while being cut is held down on the table by round-head screws which screw into sliding nuts in the table slot. This nut is made of machine steel and is used for clamping all planer work, it being found to hold better than the bolt.

This method of cutting rack has been in use for several years and has been found entirely satisfactory.

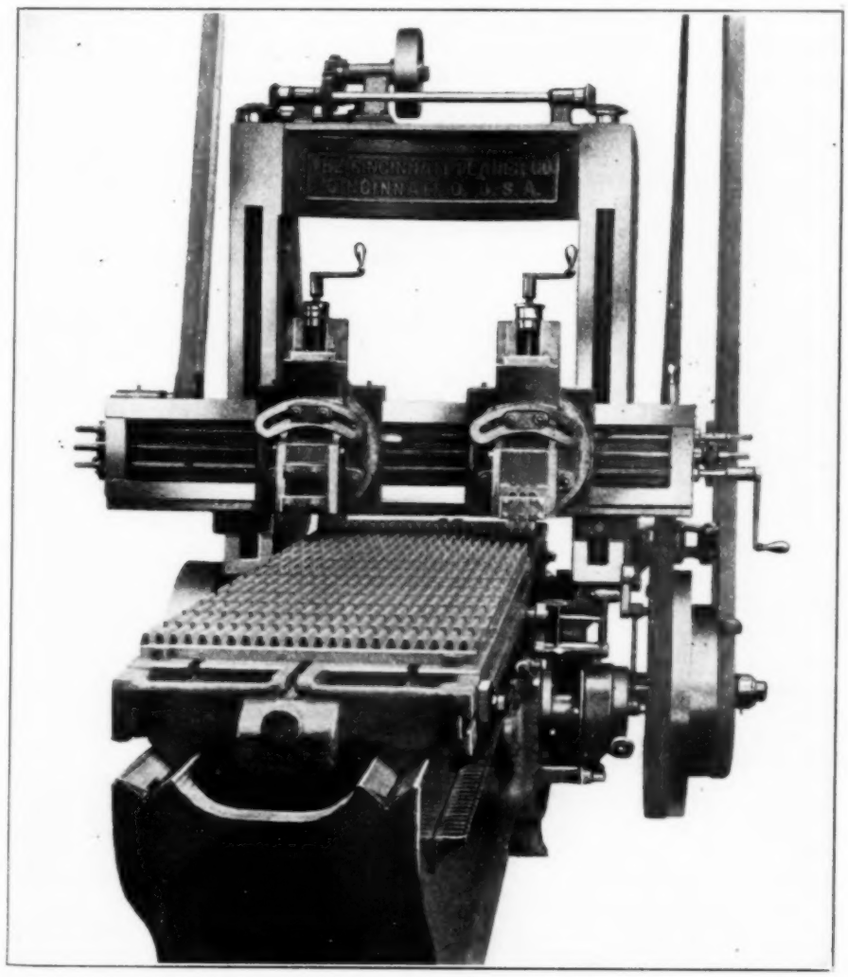


FIG. 5. PLANING RACKS IN LOTS

Time and Cost of Designing a Gasolene Engine

By Morris A. Hall

The article concerning which I have chosen to give the cost and time of designing is a gasolene engine of the four-cylinder, vertical, four-cycle, water-cooled type. This was designed primarily for use in gasolene-driven railroad cars and locomotives and secondarily for marine use. It is shown in several views in Fig. 1.

The drafting force consisted of the chief engineer, chief draftsman, two senior designers, one junior designer and detailer, from two to five detailers and tracers, one filing clerk, one stenographer and one chief clerk, a total of ten to thirteen. The time and expense of the first named and the last two are not figured in here. Similarly, as the blueprint boy was shared with two other departments no record was kept of his time.

In this particular case the chief draftsman practically completed the design and some of the details himself. The main design having been settled, the detailing was started. This was done in either one of two ways. If the work was in no particular hurry the design drawing of a group, as for instance the pump, was made, dimensioned and handed in. The chief draftsman after looking them over distributed these to the detailers who picked out from these assemblies the individual pieces and made detail drawings of them. These detail drawings were handed in for inspection. The other method which was used in cases of a rush job was as follows: The designer worked up a drawing of a group and then made freehand sketches of the individual parts with all dimensions. This he was able to do very rapidly. These sketches, made on special paper provided for that purpose, were handed in to the chief draftsman who looked them over, and distributed them to the detailers and tracers who made scale drawings and traced them. As all dimensions were given this made a very quick job, in fact I have had a designer turn out over 70 sketches a day, which is equal to a sketch every 8 minutes, and a tracer draw up and trace over 30 per day which would be a drawing and

tracing every 18 minutes. These figures, of course, represent maximum production.

In the case of working from sketches, the tracing and sketch went back to the designer to be compared and checked. Then the tracing was handed in. In the former case of working from the group drawing, the details were regularly traced and handed in to be checked.

As these tracings were checked, they were given to the filing clerk who took out drawing numbers for them in a series of serial number books, one for each size. He also placed the number on the tracing and made out two index cards for each drawing, one for the numerical and the other for the alphabetical index. When all the drawings were completed, the bill of material was made out, all parts entered therein and all drawing numbers given. This was then copied on a printed bill of material forms using pencil on the paper ones and ink on the tracing cloth. The former was used in this and in the case of all new designs. Then all of the tracings and bill of material were returned to the chief draftsman who ordered the number of blueprints required on a special blueprint order slip, a duplicate being kept to insure prompt delivery of the blueprints and the return of the tracings to the drawing room.

The engine was designed complete, that is, no old part or parts from other engines were utilized nor was anything left to be "decided later" as is often the case. The engine as finished to the drawings was ready to connect up and run.

The men working on this particular job were nine in number and the total number of hours spent on it were 769. The men with their rates were, chief draftsman on design, checking supervision and issuing part of the time at 40 cents per hour, part at 56 cents; designer on assembly and part checking 43 cents; first-class detailer on details and minor points in design at 33 cents; one detailer and tracer at 19 cents; one each at 19, 22 and 18 cents, two at 17 cents, one tracing and filing clerk at 17 cents; order boy at 14 cents.

For convenience I have placed the summary in tabular form shown in Fig. 2. In this I have divided the work into six main groups consisting of, the design, which includes all the work of the design proper, both large and small parts, and includes all time of computations; the detailing, this is complete and includes the drawing up and dimensioning of the various parts; the tracing, every drawing of every part was traced and this includes the time necessary to do that work; the assembly, this I consider very important and put my best man upon it; checking, this includes only such time as was used in proving the accuracy of the finished drawings preparatory to issuing them; filing, indexing and issuing, this includes all other time put on the work and leaves the engine as a whole in the shop, in other words this completes the job.

Division.	Time and Cost.	Total Time.	Total Cost.	Per Cent. Time.	Per Cent. Cost.
1. Design.....	177 hours—$81.42	177	$81.42	23.0	31.1
2. Details.....	95 hours—$53.20				
	33 hours—$10.89				
	29 hours— $6.38				
	157 hours—$70.47	157	$70.47	20.5	26.9
3. Tracing.....	88 hours—$16.20				
	39 hours— $6.63				
	14 hours— $2.52				
	32 hours— $6.08				
	115 hours—$19.55				
	288 hours—$50.98	288	$50.98	37.4	19.5
4. Assembly.....	32 hours—$13.76	32	$13.76	4.2	5.2
5. Check.....	20 hours— $8.60				
	55 hours—$30.80				
	75 hours—$39.40	75	$39.40	9.7	15.0
6. Filing, etc....	30 hours— $4.20				
	10 hours— $1.70				
	40 hours— $5.90	40	$5.90	5.2	2.3
Grand total..		769	$261.93	100.0	100.0

FIG. 2. TIME AND COST OF THE ENGINE DESIGN.

From Fig. 2 we see that the design occupied 177 hours or 23 per cent. of the total, approximately ¼, the details took 157 hours or 20½ per cent., roughly ⅕, tracing occupied 288 hours or 37.4 per cent., while the assembly took up 32 hours or 4.2 per cent. Then checking required 75 hours or 9.7 per cent. and the remainder, 40 hours or 5.2 per cent. was spent filing and indexing.

Thus we see that the design, details and checking took up 409 hours total or 53.2 per cent. of the whole. This would show that tracing, the assembly and the other work took the balance of the time, 360 hours, equal to 46.8 per cent.

Now as to cost we see that this varies differently from the time. The designing cost $81.42, which is 31.1 per cent. of the total of $261.93. This we see is an increase over the time taken which was but 23 per cent. This was to be expected as the highest priced men work on the design. Coming to the details, we find another increase, the amount $70.47 being 26.9 per cent., whereas the time for this work was but 20½ per cent. Passing next to the tracing we see a big change, $50.98 is but 19½ per cent. of the whole, while the time spent was 37.4 per cent. The assembly amounted to $13.76 or 5.2 per cent., the checking to $39.40 or 15 per cent. and the miscellaneous work $5.90 or 2.3 per cent. Grouping, as before, the designing, detailing and checking amounted to $191.29 which is 73 per cent. So we see that what appears to be red tape really takes, not ½ as it appeared to, but ¼ of the cost, or $70.64, which is, to be exact, 27 per cent. If we could separate out from this the really necessary part we would find that this dropped below one-fifth.

Then we have the total drawing cost of $261.93 and the total number of hours time occupied 769, which is an average rate per hour of 34 cents.

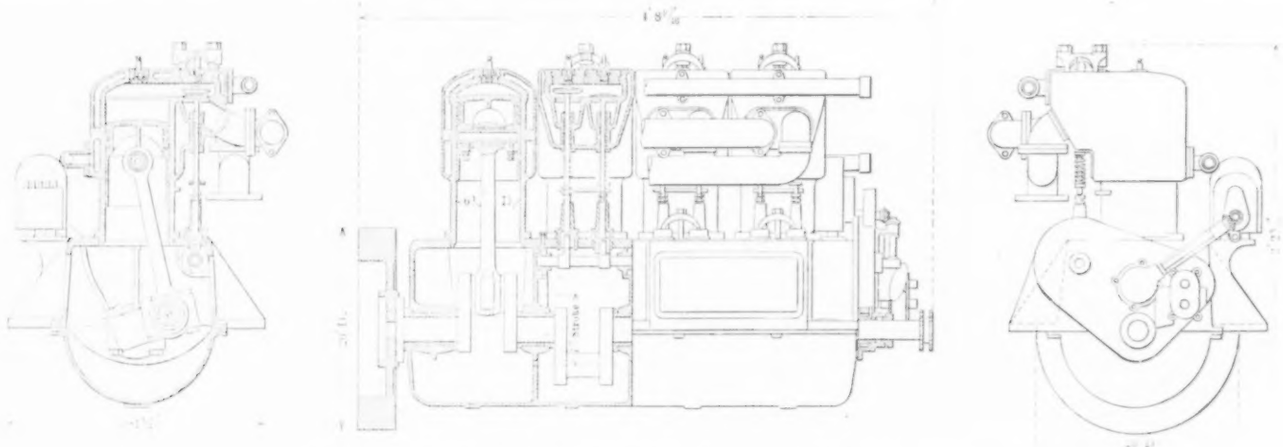


FIG. 1. ASSEMBLY OF A FOUR-CYLINDER 6½X7-INCH GASOLENE ENGINE

Practical Letters from Our Readers

A Round Table Discussing Details of Modern Machine-shop and Drawing-office Methods, Practice and Economy

WE PAY FOR USEFUL IDEAS

Die and Drilling Jig for a Typewriter Part

During a recent visit to the Remington-Sholes typewriter factory, Superintendent Sargent took especial pains to show me the many interesting things to be seen there, among them being the drill jig and the punch and die used in machining the right and left upper-feed roller arm. Both the jig and the die are the design of C. A. Diller, the toolroom foreman.

Fig. 1 shows two views of this small brass upper feed-roller arm. The piece at the right should show five small holes on one side of the large hole, but no finished pieces were at hand when the photograph was taken, and they are given just to show the shape of the piece.

Before being placed in the die, the brass pieces are put into a special machine which flattens the sides out smooth and saves any subsequent machining.

They are then placed in the die, Fig. 2, which is made for both right and left pieces, and the large hole is punched through both sides, and the small hole in the end of the fork punched through one side only.

As will be seen on inspection, the large punch pierces the upper side and then shoves the slug down through the other side. The small hole is punched singly as a guide for the piece when placed in the drilling jig.

All the punches and dies used in this factory are placed in sub-presses which is by far the best method wherever it is possible, for though the first cost is more, this is more than offset in the time saved in subsequent settings and in the life of the punches and dies.

Another idea which Mr. Diller uses is hardened bushings in which the small punches are set. By using these the breaking of a punch isn't so apt to damage the punch block. While the use of these bushings is not original with him, yet they are not as universally used as they might be.

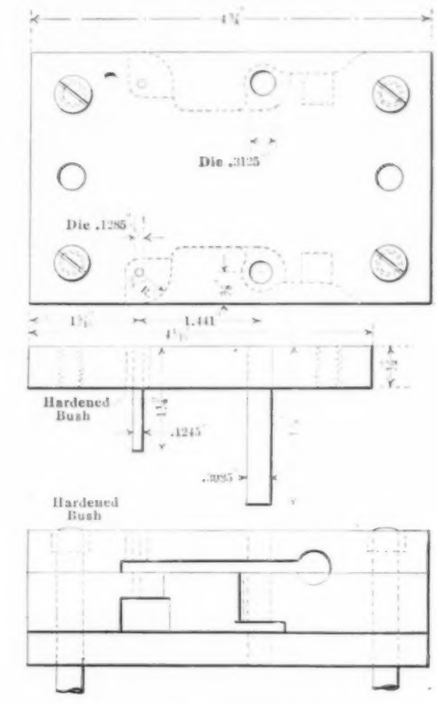
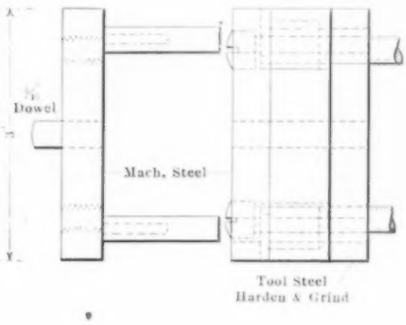


FIG. 2. THE PIERCING DIE

FIG. 1. THE PIECES TO BE PUNCHED AND DRILLED



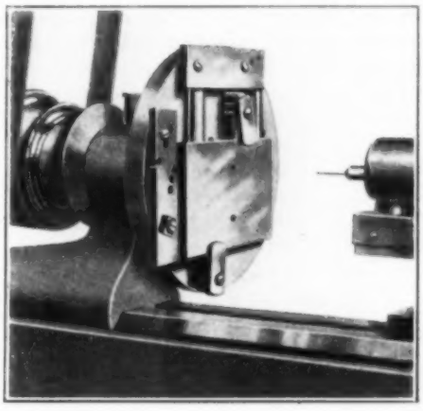


FIG. 4. LOCATING AND BORING HOLES IN JIG PLATE

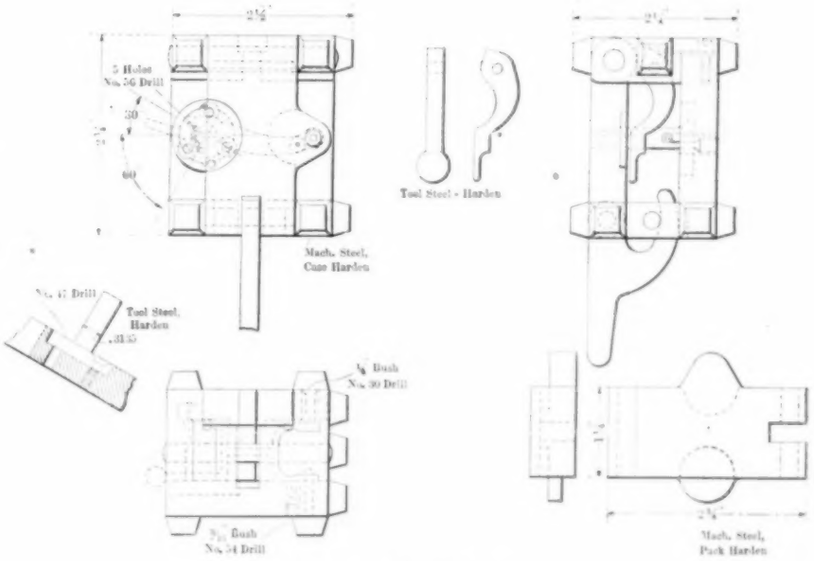


FIG. 3. THE DRILL JIG

After the two large and one small hole are punched in the roller arm it is placed in the drill jig, Fig. 3, which shows the jig for drilling the left-hand arms. The large holes slip over one pin and the small one over another, which brings the upper arm in position for the drilling of the No. 30 hole and also lines the pieces up in correct position for the five No. 56 holes.

The latch on this jig is a great improvement over many in use and not only locks the top firmly in place, but also serves as a handle in manipulating the jig and in operating the "knock-out."

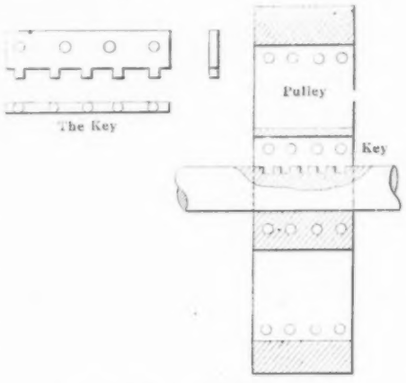
In connection with this, Fig. 4 shows the method used in locating and boring holes in jig plates. The jig plate is strapped to the face plate and the hole nearest one corner is centered. Two steel strips are then bolted at the opposite corner at right angles to each other and closely in contact with the edges of the jig plate. After the first hole is bored, holes any required distance from it are located by simply placing two plugs the right length between the edge of the jig plate and one of the steel strips.

If the next hole to be bored is not squarely in line, four plugs of suitable length are used, thus moving the jig plate the proper distances from each strip. A large number of plugs of various lengths are on hand and it is but the work of a few minutes to make others when needed. No further explanation of this scheme is needed as any toolmaker to whom the method is unfamiliar will at once see its application.

Decatur, Ill. ETHAN VIALL.

A Key for Wood Pulleys

After installing a high-speed machine some time ago we found the driving pulley on the main shaft slipping and it gave us an endless amount of trouble, as we had to close down to tighten it up. By adding to the wrench a piece of gas pipe for leverage we could not tighten this pulley. Therefore I had the millwright make a key like the illustration which did the trick. I have since had every wood pulley in the shop provided with this same key.



A KEY FOR A WOODEN PULLEY

The key is made of flat stock cut off for standard pulleys. A number of these are planed at the same time, leaving square projecting lugs which are milled round by using a hollow mill on drill press.

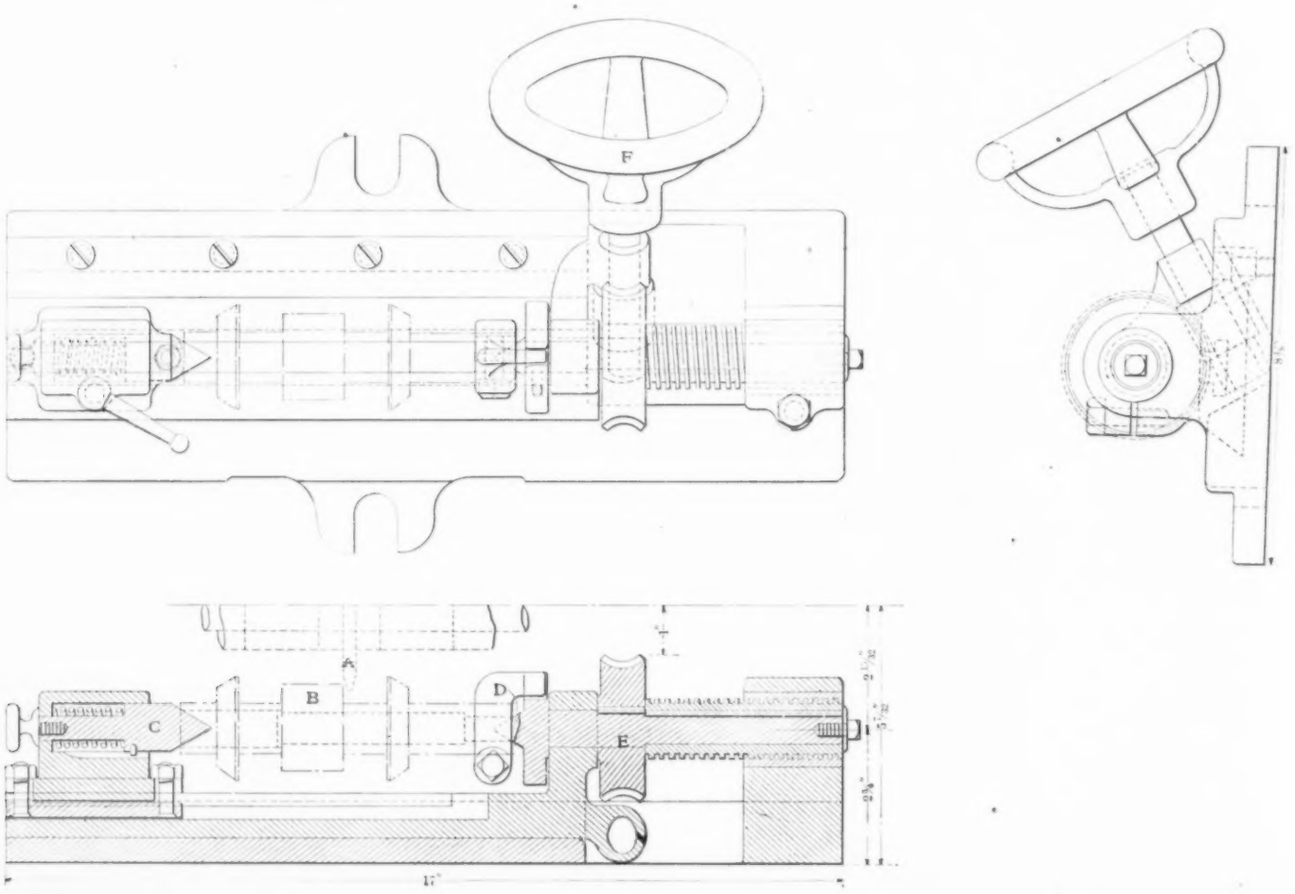
The shaft is drilled to suit these lugs by using a ratchet. The holes in key are drilled to suit pulleys.

Boston, Mass. I. N. Q.

A Worm-milling Fixture

The drawing shows a worm-milling device to be used on a plain milling machine. I have had considerable trouble in cutting worms of heavy pitch on the lathe and so I designed and made one of these fixtures, which is very successful as I can now have worms milled by an apprentice boy for 2½ cents each that used to cost 25 cents.

The milling fixture is set on an angle corresponding to the angle of the thread to be milled, the cutter *A*, placed on the milling arbor and the worm *B* to be milled placed between the centers *C D*. The depth of cut is measured from the outside diameter by the elevating screw in the milling machine. There is a small spindle at *E* (for center *D*) and to this spindle are attached a master worm or screw of the proper lead, and a worm



WORM-MILLING ATTACHMENT

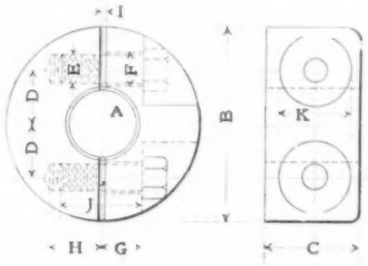
gear. The spindle is operated with a worm turned by the hand wheel shown, and as the work is fed along it is also fed to the cutter.

Grand Rapids, Mich. JAS. MORRIS.

Proportions and Jig for Clamp Nuts

Clamp nuts, such as are shown in Fig. 1, are generally used on shafts where it is necessary to take up end wear or play between two abutments. One abutment is generally rigidly attached on the shaft and the other, or clamped nut, is adjustably attached. These clamp nuts are made circular in form to eliminate all projections and thereby adapt them for use on revolving parts. They are also adaptable to places where check nuts would otherwise be employed.

The proportions given in the table, Fig. 1, are based upon the diameter of the threaded hole in the nut. The pitch of the thread for the different diameters has been adopted as 12 per inch, V-thread. As can be seen from the table, the proportions have been arranged for holes increasing by ¼ inch. If a nut is required for holes in sixteenths or eighths the proportions for the next larger hole can be used. The proportions have been made for each ¼-inch increase in hole diameter



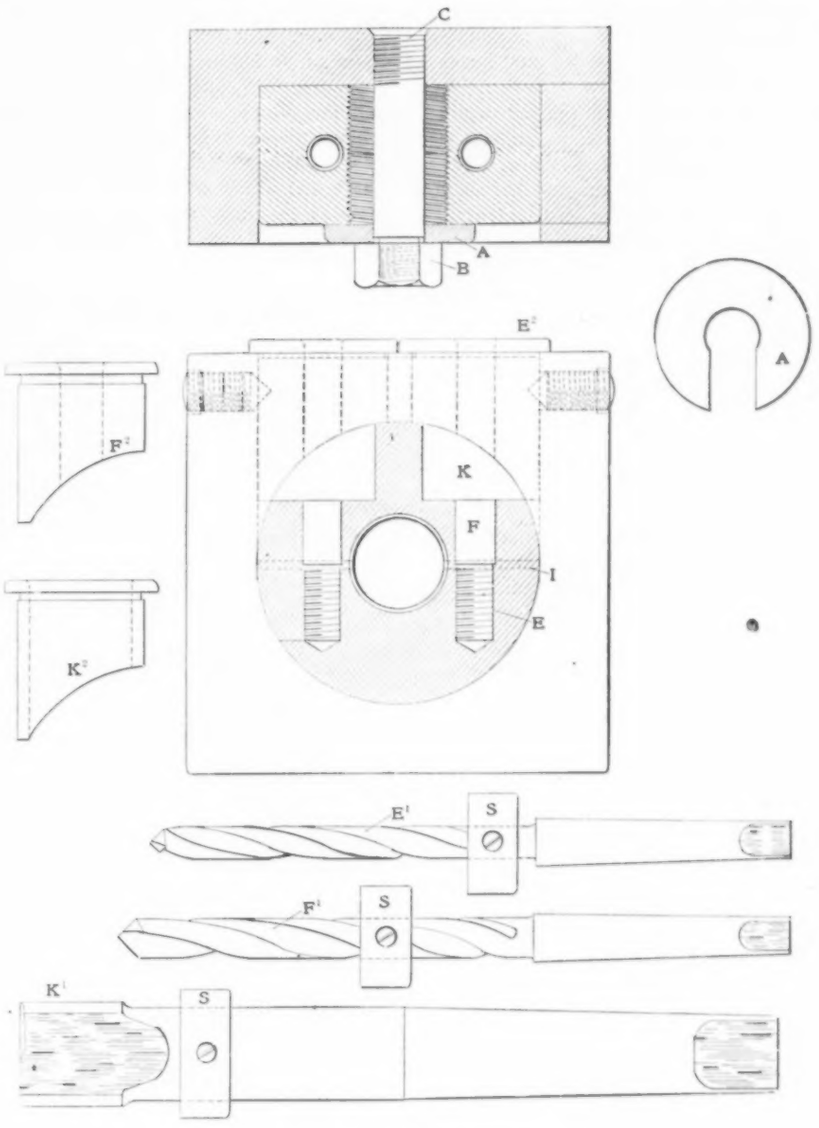


FIG. 2. JIG AND TOOLS FOR CLAMP NUTS

A	B	C	D	E	F	G	H	I	J	K	Stock No.
1" x 12"	2¾"	1⅜"	¾"	⅛"	21/64"	9/16"	¼"	1/16"	1¼"	1"	1
1¼" x 12"	3"	1½"	⅞"	⅛"	21/64"	⅝"	⅞"	1/16"	1¼"	1"	2
1½" x 12"	3⅜"	1½"	1"	⅛"	21/64"	11/16"	1"	1/16"	1½"	1"	3
1¾" x 12"	3¾"	1½"	1⅛"	⅛"	21/64"	¾"	1⅛"	1/16"	1½"	1"	4
2" x 12"	4⅜"	2"	1⅝"	½"	21/64"	13/16"	1¼"	⅛"	1¾"	1⅛"	5
2¼" x 12"	4⅝"	2"	1⅞"	½"	21/64"	⅞"	1¼"	⅛"	1¾"	1⅛"	6
2½" x 12"	4⅞"	2½"	1⅞"	½"	21/64"	15/16"	1¼"	⅛"	2"	1⅛"	7
2¾" x 12"	5"	2½"	1 11/16"	½"	21/64"	15/16"	1¼"	⅛"	2"	1⅛"	8
3" x 12"	5⅜"	3"	1 13/16"	½"	21/64"	15/16"	1⅜"	⅛"	2"	1⅛"	9

FIG. 1. PROPORTIONS FOR CLAMP NUTS

to facilitate manufacture, and to reduce the number of tools necessary for their production.

The material can be either steel or cast iron; however, with the modern automatic machines the smaller diameters will be found to be more economically produced of steel.

The jig and tools for drilling the bolt holes are shown in Fig. 2, and are for the smallest clamp nut. Hexagon cap-screws are shown, but fillister-head screws can be used if desired. It will, however, be found that the cap-screws are more efficient. The jig is practically square in construction and of a thickness so it can be counterbored to receive the clamp nut and allow metal for properly securing the stud *C*. The clamp nut is centered by its outer diameter and clamped in place by the nut *B* and collar *A*. The collar *A* is slotted so it can readily be removed without entirely unscrewing the nut *B*, and allows the clamp nut to be taken out.

One end of the jig is bored out to receive the different sized bushings which are held in place by cone-point headless screws. The bushing E^2 is the first bushing put in place. The twist drill E^1 is used to drill the tap hole to the full depth, as indicated by the stop collar S, which is held in place by a headless screw. The next bushing is F^2, and the full-size drill F^1 enlarges the tap hole for half its length, as shown. The counterboring is then done by K^1 which is guided by the bushing K^2. The clamp nut is then removed, and can be cut in two, and the lower half tapped out.

WILLIAM F. ZIMMERMANN.

Newark, N. J.

Dies for Threading Alloy Castings

Many attempts had been made to thread some brass fittings, of a special alloy, with dies of the spring, solid,. and

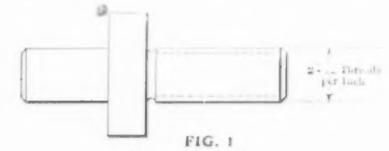


FIG. 1

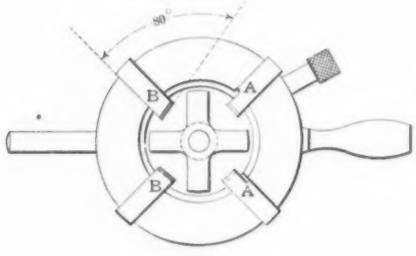


FIG. 2

THE WORK AND THE DIE

self-opening type but every attempt had been unsuccessful owing to the material filling up the dies.

After some time it was decided to fit up a Potter & Johnston machine with a geometric diehead, so a style C was used, being carried in a floating holder in the turret. The cam strip on the cam drum traveled the diehead about four threads on to the work and then allowed the turret to dwell while the portion already threaded was intended to traverse the diehead to the end of the thread, but the dies filled rapidly and really acted like a hollow mill, and a lot of scrap was turned out before the job was successfully tackled. Fig. 1 shows the work, Fig. 2 a front view of a regular geometric self-opening diehead with internal trip, and at A is shown the usual style of dies sent out with these dieheads. The cutting edge leads the center by about ⅛ inch. This cutting edge we reduced to the center and latterly behind the center but to no purpose and it seemed as though we should have to give the job up.

Dies at B show how the difficulty was overcome, i.e., by leaving the dies full thickness of the steel, having the cutting points lead the center by about ¼ inch and milling them with a straight clearance cut of 10 degrees.

We were then able to turn, drill and thread the pieces automatically with one chucking, taking only one cut with the diehead, without a lubricant and turning out a thread which was all that could be desired as to pitch, size, and finish.

Glasgow, Scotland. M. E. K.

A Drift for Bushings

The line cut shows a very simple device used to drive bushings into position. The

A DRIFT FOR BUSHINGS

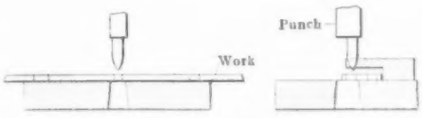
unsatisfactory method of driving brass or cast-iron bushings into place with babbitt blocks or wooden blocks to prevent marring is herewith eliminated. The small diameter of the plug is slightly under the size of the bore of the bushing while the large diameter of the plug is slightly smaller than the outside diameter of the bushing. The shoulder that takes the thrust has a ¼-inch fiber washer, which can easily be replaced when worn. Plugs are plainly stamped with the bore and outside diameter of the bushing for which they are to be used.

By using the above method and having all standard sizes of the plugs, we have prevented spoiling many bushings.

Cincinnati, O. A. HELM.

Punching D-Notches

Some time since an order for 2000 strips of the kind shown was sent to the jobbing shop where I was employed. As



THE WORK AND NOTCHING PUNCH

this order was small the cheapest tools which would do the work were made.

There were four screw holes to be pierced, and five notches to be cut in one edge of the strip.

A plain die and a simple locating arrangement were made for piercing the screw holes. The holes indicated by the dotted circles in each of the slots were also pierced in this die.

A notching punch and die were then made. In the punch was a long pilot which reached almost to the work when the punch was at its highest position.

After the piercing, the strips were pressed against the combined guide and stripper on this die for alinement, while the operator set the holes under the pilot of the punch by eye and made the slots.

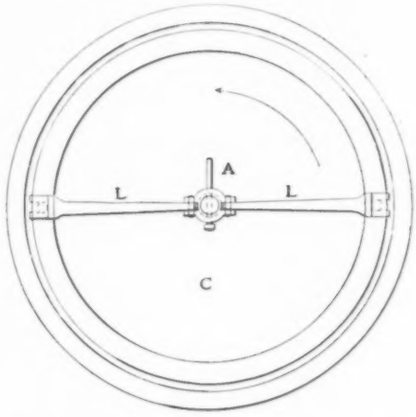
The use of but one locating operation and the piercing of the holes for the slotting punch made a satisfactory job which was much cheaper than could have been done with any other arrangement.

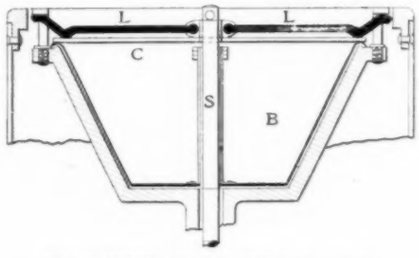
Brooklyn, N. Y. OBSERVER.

Cover-holding Device for an Oil Separator

A centrifugal oil separator wore out by having the thread on the central spindle S strip. The operator barely missed death by dodging the hand-wheel as it went through a window, so the change shown was decided on.

The spindle S was drilled to take a





THE HOLDING DEVICE FOR THE COVER

half-inch bolt and the levers $L\,L$ were made from flat stock, two studs $R\,R$ were placed in the flange on the bowl B and the heads on the studs formed so that the cover C could be easily removed.

The cover could be more quickly removed than with the old hand-wheel hold down, as the bolt A could be slipped out easily, the centrifugal force being ample to hold it in, and the two levers and central connection weighed much less than did the hand-wheel.

The scheme was a success and showed no signs of wearing out after two years' service.

Chicago, Ill. C. C. M.

Micrometer Stop for Vertical Spindle Machines

We have at our factory a Knight vertical milling and drilling machine for which we have devised a stop for the downward movement of the spindle whereby we may take off a known amount of metal without the cut-and-try method. The same device may be adapted to all vertical milling and drilling machines whose spindles are driven in the usual manner; that is by a key in the pulley.

Fig. 1 is the assembled view together with a portion of the driving pulley; Fig. 2 shows the details. *A* is the binding collar, nurled its entire length, made of mild steel and case-hardened. The four slots are for a spanner wrench. The taper hole which is 10 degrees included angle receives the binding bush shown at *B*. The threaded portion is fitted to the small end of threaded sleeve *C* which, coming in contact with binding bush *B*, compresses the split bush, thus binding the stop to the spindle. The taper binding bush *B* is made of tool steel hardened and ground. One slot is open at the thin end while the other is open at the thick end, thus allowing it to compress evenly. *C* is of tool steel and made an easy sliding fit on the spindle; it is kept from turning independently of the spindle by a pin in the threaded hole.

Graduated collar *D* is of cast iron, the smaller part being nurled to form a good grip for the fingers. The beveled portion is graduated in 50 divisions, and the inside threaded 20 per inch. This collar in connection with zero collar *E* forms the stop. Collar *E* is a shrink fit on the top of the hub of the driving pulley.

Upon bringing the mill down upon the work or taking off a sizing cut the stop can be clamped in position, first having unscrewed graduated collar *D* a few turns. Ascertaining the amount to be taken off, the collar can be turned back the required number of graduations, thus allowing the cutter to come that much closer to the table of the machine.

St. Louis, Mo. E. A. S.

A Good Piston Ring

The accompanying illustrations show a machine and fixture used in machining piston rings without inside finish.

Such a ring is much better than the "finish all over" ring as it has much more elasticity and is not as likely to receive a permanent set in springing over the piston into the grooves. It is also cheaper to manufacture.

A special machine, as in Fig. 1, is used. The chucks, which are shown in Fig. 4, are carried on the end of the spindle and a four-tool turret head is used on the carriage.

The carriage has two feeds, one for the roughing tool and a coarse feed for the flat end finisher. A straddle tool is used for roughing and another for finishing the sides of the ring which, of course, is completed at one chucking.

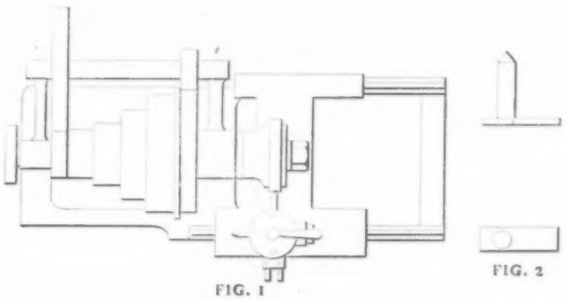


FIG. 1

FIG. 2

FIG. 3

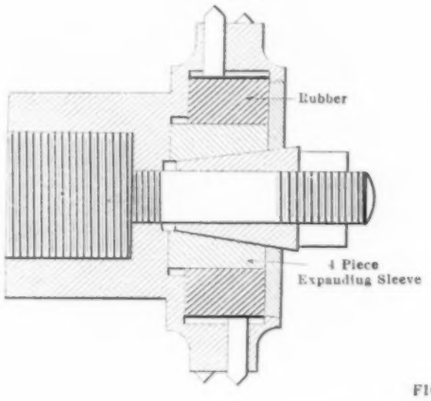
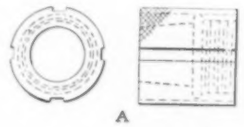
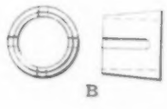
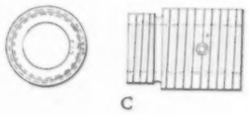


FIG. 4

MACHINING PISTON RINGS







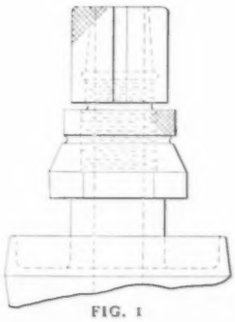


FIG. 1

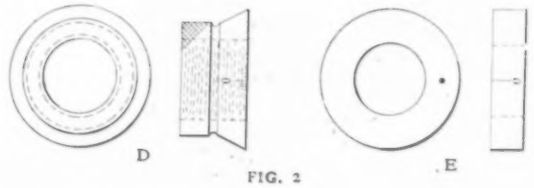


FIG. 2

MICROMETER STOP FOR VERTICAL-SPINDLE MILLING AND DRILLING MACHINE

The chucks are off center corresponding to the amount of eccentricity of the ring. The rings, instead of being cast in blanks are cast single from metal patterns and very near size, only a small amount of stock being removed from the outside diameter and sides. The castings are well tumbled and come from the foundry in fine shape.

The chucks, Fig. 4, one for each diameter of ring, have a large number of pointed pins which are hardened on points. There are two complete rows or circles of these, equally spaced, a development being shown at Fig. 3 of the pins as they appear on the inside of the chuck. Each pin has a piece of sheet steel riveted to the shoulder end. These steel pieces present a good surface for the rubber collar when the four-piece sleeve is expanded by the taper bushing. A cap screwed into the face of the chuck retains all the parts in position.

When a ring is placed in position to

machine and the nut is run up, should one or more pins strike any irregularity in the inside surface the rubber collar will bring all the other pins in contact with equal pressure and the ring will be held true and firm.

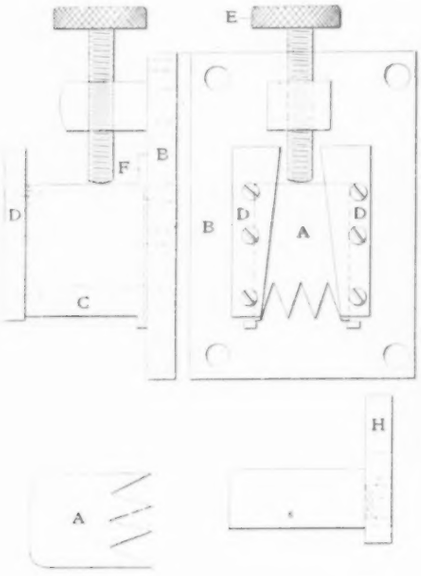
The turning and facing tools are of high-speed steel, and once the machine is set up a boy can machine the rings very fast.

I do not know of anyone using this kind of ring on gas engines, but see no reason why it would not be practical.

Madison, Wis. Y. ZIEGLER.

Cutting Teeth on a Punch Press

Having a quantity of bronze blocks in which teeth had to be cut, as shown by *A* in the sketch, the milling machine was first tried, with a special cutter, and found to be too slow. The punch press



CUTTING TEETH ON A PUNCH PRESS

was then used as follows, with good results:

The block to be machined measured 2½x3½x3½ inches; a cast-iron plate *B* was drilled so as to allow it to be bolted to the press, and uprights *C* screwed fast to it in such a manner as to have the block *A* a tight sliding fit between them. Top straps *D* were placed on the uprights to prevent the block from tipping as the tool came in contact with it. The top straps pressed quite heavily on the block, and the screw *E* was used to feed the block forward. The bottom plate *F* raised the block high enough to allow the cutting edge of the cutter *H* to pass clear through the thickness of the bronze blocks. The blocks *A* were first sawed out roughly, then slotted, as shown. This operation gave great satisfaction, as it was very speedy and accurate.

West Orange, N. J. G. E. WHITE.

German Emery-wheel Guards

Figs. 1 and 2 show the design, construction and method of using a German elastic-steel guard for emery wheels, and Fig. 3 the result of the bursting of an emery wheel in one of these guards.

The guard is made up of bands of corrugated sheet steel 1½ millimeters in thickness, several bands being held together by cross-bars or framework bolted together in such a manner as to form an elastic guard which is said to be very effective in gripping and holding the parts of a broken emery wheel and keeping them from flying, thus avoiding serious accidents to life and property.

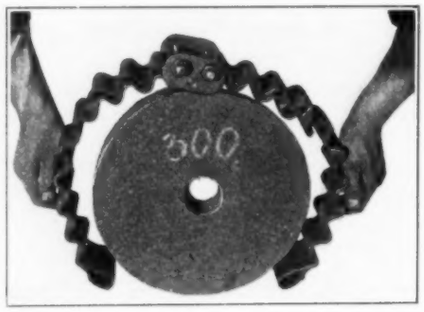


FIG. 1. SPRINGING GUARD INTO POSITION FOR BOLTING TO FRAME

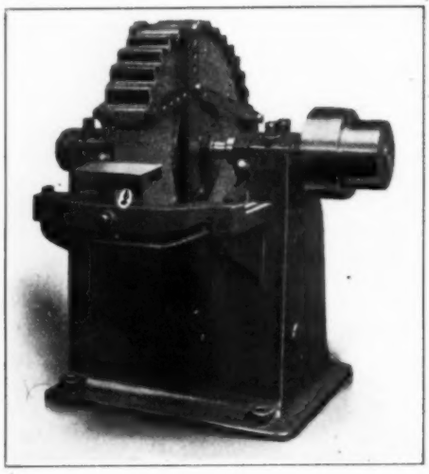


FIG. 2. EMERY WHEEL PROVIDED WITH ELASTIC GUARD

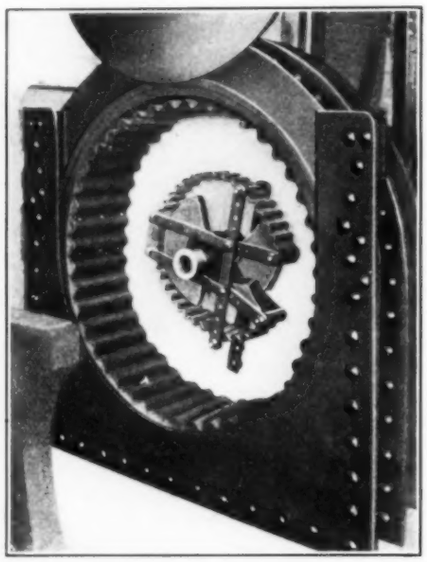


FIG. 3. SHOWING BROKEN EMERY WHEEL

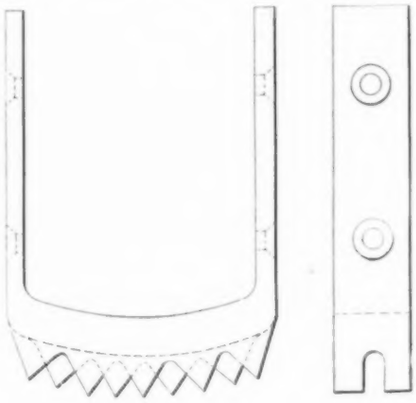
With this flexible guard the emery wheels tested ranged from 400 millimeters to 700 millimeters in diameter with speeds varying from 680 to 1650 revolutions per minute.

This form of elastic emery-wheel guard was designed and constructed at Hannover-Hinholz by the Vereinigte Schmirgel- Und Maschinen-Fabriken.

Buffalo, N. Y. FRANK C. PERKINS.

To Prevent Ladders from Slipping

Having seen a great number of ladders slip when used in a machine shop with wooden floor, I devised the foot shown in



FOOT FOR LADDERS TO PREVENT SLIPPING

sketch herewith, which has been very successful. They are made of malleable iron and are very cheap to make. The sketch herewith is for a ladder 3 inches wide at foot and has 10 staggered teeth on bottom about ¾-inch centers. It is fastened to the ladder with ordinary wood screws, and adds almost nothing to the weight of ladder.

Sheffield. J. R. M.

Fluting Wooden Handles in the Punch Press

We had a number of wooden handles to flute. We first tried to flute them by using a nurl but this gave poor results. We then made a die to push them through using lard as a lubricant which gave excellent results. We have used the same

method with satisfaction on brass and german silver.

We made the die by making a broach with the correct flutes and forcing it through the die blank after which the corners are rounded off smooth and the die hardened.

Buffalo, N. Y. G. R. CARLSON.

Some Hints on Shaper Design

Most machine tools undergo changes in design, and, in general, all changes are in the direction of improvement. The weight and rigidity are increased, and the workmanship, accuracy and appearance are improved. But the improvements which have taken place are much more conspicuous in some tools than in others, and I believe the usual design of shapers shows considerably less improvement than other machine tools do. The points for improvement, as I see them, are as follows:

First, the method of fastening the rail to the column.

Fig. 1 shows the rail, apron, table and vise of the usual design. *A* is a clamp bolt, there being two of them, one on either side, and these two clamp bolts have a very important duty to perform. They are quite generally supposed to rigidly fasten the rail to the column. To improve this I would suggest the construction shown in Figs. 2, 3 and 4, which would add greatly to the stiffness of the machine.

Second, the method of fastening the table to the apron.

Referring again to Fig. 1 a large number of shapers are built in which the table is bolted to the apron by T-head bolts, and it is obvious that the greater part of the stress due to the cut must be resisted by the bolts in the upper slot. By making the table and the apron in one piece, the convenience of the shaper would not be appreciably decreased, but the rigidity would be very greatly increased.

Third, the method of gibbing the apron to the rail.

Fig. 1 shows that the placing of the gib between the groove in the apron and the tongue on the rail introduces another source of weakness as the whole pressure on the apron is transmitted by three or four small gib screws. When it becomes necessary to adjust this gib we move the table out to one end of the rail, block up the outer end, then set up all the screws we can reach, moving the table to the other end of the rail to complete the adjustment. By placing the gib in the front side of the groove as in Fig. 4, all necessary adjustments can be easily and quickly made, and the construction will evidently be much more rigid.

Fourth, the ram slide.

Most rams are made with square slides which are provided with adjustment on one side and both upper faces. The ram is subjected to a considerable upward pressure due to the cut and this upward pressure is often resisted by a few small fillister head screws. While these screws are not as badly overloaded as the clamping bolts which fasten the rail to the column, the construction shown in Figs. 2, 3 and 4, would afford easy adjustment and also add greatly to the rigidity.

Pittsburg, Penn. M. O. MCKEE.

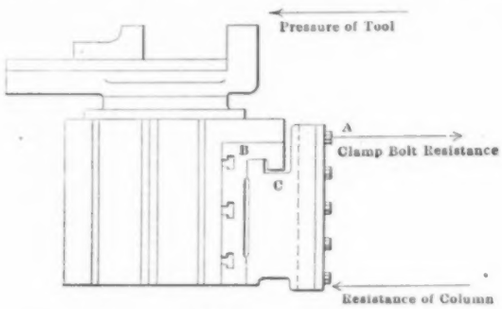


FIG. 1

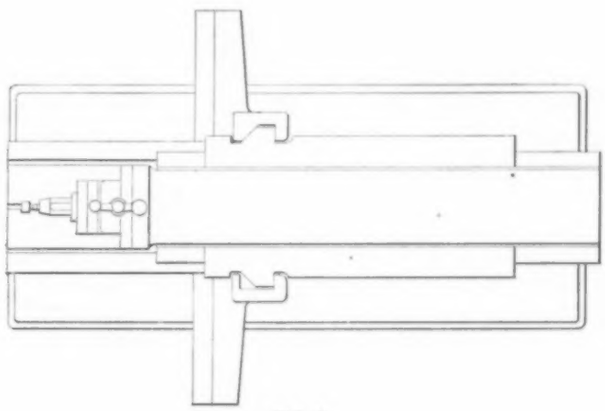


FIG. 3

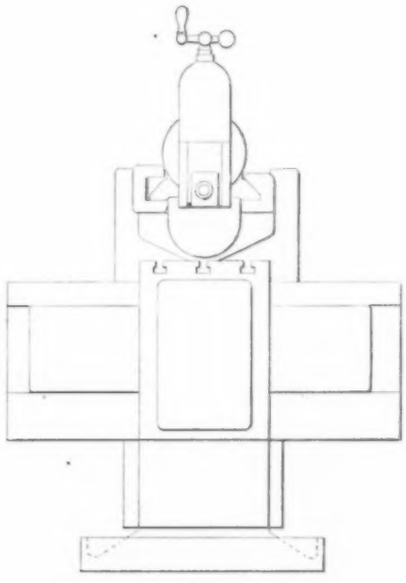


FIG. 2

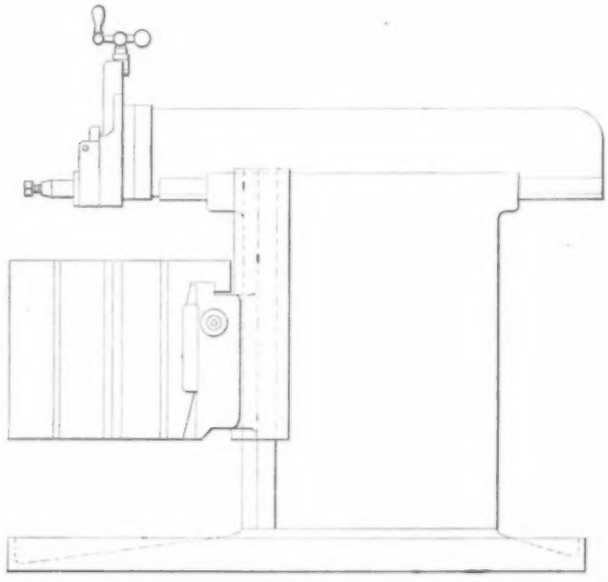


FIG. 4

HINTS ON SHAPER DESIGN

Discussion of the Previous Question

Letters from Our Readers Showing How Many Men of Many Minds Look upon Various Subjects Opened up in Previous Numbers

WE PAY FOR THESE ALSO

Power Required by Cranes

For the last few weeks I have been testing overhead traveling cranes. I was, therefore, delighted to see "Power Required for Cranes," by Albert D. Harrison, on page 964, Vol. 31, Part 1, and at once I attempted comparisons, but soon was in a fog and shall be glad if Mr. Harrison can help me out of it.

Referring to the formula for brake horsepower: Where does it come from? How is it derived? I can understand taking the diameter of the traveling wheels into consideration, but I do not think the brake horsepower varies directly as the reciprocal; that is to say, if the diameter of the traveling wheels is 12 inches and 20 brake horsepower is required, increasing the diameter of these wheels to 24 inches, only 10 brake horsepower will be required according to the formula. I take it that the axles referred to are the axles of the traveling wheels. Why consider these separately from the rest of the gearing when 70 per cent. of the brake horsepower is taken for efficiency?

One crane that I tested has 36-inch diameter driving wheels with 5-inch diameter axles. This crane weighed 45 tons and was moved along at a speed of 400 feet per minute with 55 amperes at 210 volts. This corresponds to 15.5 horsepower; assuming 90 per cent. efficiency of the motor, the brake horsepower = 14. When carrying 10 tons (the maximum working capacity of the crane) the volts were 210 and the amperes 57.5. This at 90 per cent. efficiency equals 14.5 brake horsepower, and the speed = 380 feet per minute. See the accompanying table, in which

W = Weight of moving structure,
S = Speed in feet per minute,
D = Diameter of traveling wheels in inches,
d = Diameter of axle of traveling wheels in inches.

It appears to me that if 0.1 is taken at the axles and 0.035 at the wheels the formula should be the following:

Horsepower necessary to overcome friction on axles =

$$\frac{0.1 \times 2240\ W\ S\ \frac{d}{D}}{33{,}000} = 0.00094\ W\ S$$

Horsepower necessary to overcome friction on traveling wheels =

$$\frac{0.035 \times 2240}{33{,}000} W\ S = 0.00237\ W\ S.$$

Taking this in case No. 1:
0.00094 × 45 × 400 = 17 horsepower for axles,

W	S	D	d	Volts.	Amperes.	B.H.P.	B.H.P. by A. D. Harrison	Tractive Force in Pounds per Ton.
45 tons	400	36	5	210	55	14	27.7	28.5
55 tons	380	36	5	210	57.5	14.6	32.15	25.5
11½ tons	324	12	4	215	7.5	2	14.16	19.2
21⅝ tons	200	12	4	215	15	4	16.34	33.1

COMPARISON OF FORMULA AND TESTS FOR CRANE HORSEPOWER

0.00237 × 45 × 400 = 42.75 horsepower for wheels,

Horsepower necessary for axles and wheels = 59.75.

Against this is the actual 14 horsepower and Mr. Harrison's 27.7.

Darlington, England. C. R. FOOTE.

Changing of Steel After Hardening

On page 130 of the AMERICAN MACHINIST I noted what was said regarding the changing of hardened-steel gages after grinding, and as I have had experience along this line I wish to submit the following:

Several years ago I had occasion to make a number of flat steel snap and other gages and as the metal was quite thin I had trouble in keeping the finished size correct, consequently I had to experiment more or less to find a remedy, which finally resulted in taking the steel gages and rough-grinding them, after hardening to within a thousandth of an inch of the correct size, and then placing the gage on a high-speed emery stand that had a good vibration and allow it to jar itself, and, therefore, make the inner molecules find their place in a few hours. Then the gage can be finished to size and keep its finished size intact afterward.

Rochester, N. Y. E. A. BIRCHER.

A Corliss Valve Gear Problem

On page 61, E. H. Lockwood proposes for solution a problem of a Corliss valve gear. He shows a figure similar to Fig. 1 in which A and B are fixed centers, and whose positions are given. At A an arm is attached, which corresponds to the wrist plate of the Corliss valve gear. This wrist plate oscillates through known angles α and θ, thus making the positions of a, b and c known, since their distance from A is given. Of the rest of the mechanism only the angular movement [ϕ and β] of the valve arm is known.

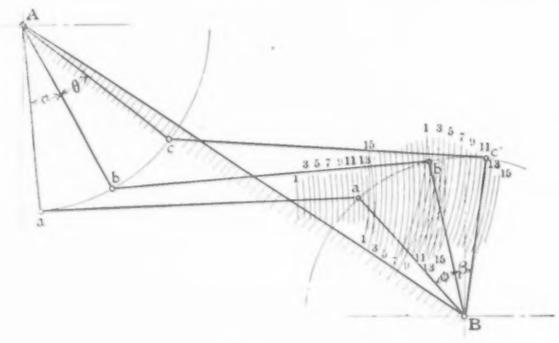


FIG. 1

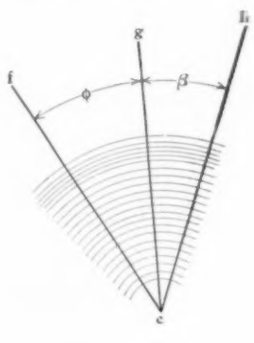


FIG. 2

TRACING WITH ANGULAR TRAVEL OF VALVE ARM

It is required to find the length of link [$a\,a'$] and the radius of the valve arm $B\,a'$, which will give the desired angular motion to the driven arm, by exact geometrical construction.

As will be seen this mechanism is what is kinematically known as the four-bar chain, having one bar or link, $a\,b$, stationary, and its solution by exact geometrical construction with the data given reminds

me of trying to trisect an angle the same way, without the use of curves or trisection instrument. Every designer is well aware of the fact that one of the chief difficulties of Corliss valve-gear design is the great number of variables. There are so many dimensions that may be varied without consequence that the great number of desirable results that may be secured by proper design are well nigh hidden. For this reason designers usually use the trial-and-error method until they arrive at results that suit them.

I give below the method I use, which is simple and accurate, and gives the value of the unknown quantities without much brain worry:

Lay off the centers A and B, and the three given positions, a, b and c, of the wrist plate, to some scale. Then with a, b and c as centers, draw arcs as shown in Fig. 1 in the neighborhood of where you think points a', b' and c will be found. Number the arcs as shown, and be sure arcs with the same numbers have equal radii. Next, on a piece of tracing cloth, lay off the given angles ϕ and β as shown in Fig. 2, and with e as a center draw a number of concentric arcs at about where the length of the arm is thought to be.

We are now ready to find the length of the valve arm and the connecting link $a\,a'$. Superpose the tracing, which is shown in Fig. 2, on the layout shown in Fig. 1, in such a way that e falls on B. Put a thumb tack through e and B. Now rotate the angles ϕ and β about B until the position is found where arcs of the same number cut the lines f, g and h at equal distances from B. When found, prick the points with a pin. If you let a', b' and c' represent these points, then $a\,a' = b\,b' = c\,c' =$ the length of the connecting link, and $a'\,B = b'\,B = c'\,B =$ the length of the valve arm, and you have the required values found.

Aurora, Ill. JOHN B. SPERRY.

Tapping Attachment for Automatic

We have been hearing and reading of late, more or less of the stories made up by "Nature fakirs." For my part I got a great deal more pleasure out of the, so called, fake stories than I did from the kicks registered by the several authorities on Nature. Once in a while I run across something in the AMERICAN MACHINIST which reminds me of the above controversy.

Take for instance the article by A. Klein on page 927 of Vol. 31, Part 1. This shows a device for getting around the stopping of the spindle for threading as used on the Acme automatic. Now I don't want to defend the construction of the above machine. The stopping of the spindle with the delicate and complicated mechanism made necessary thereby is perhaps an unmechanical device, but I will only remark that the object in stopping this spindle is in order to get a slow cutting speed for the die. The proper speed for turning soft steel using good oil to cool the tools is 80 feet per minute; for threading, 18 feet per minute. Now take, for instance, a ½-inch hexagon screw. The standard diameter for this stock is 15/16 inch, therefore your spindle will make about 320 turns per minute for turning. The diameter of the threaded portion is ½ inch, and to get 18 feet per minute needs 140 revolutions per minute. Hence to have the right threading speed he must reduce his turning speed or *vice versa*.

Now let us see further. In order to get the die off the screw he runs left hand three times as fast, therefore he must be running at a speed of 960 revolutions per minute. Considering the size of the threading spindle this speed (to use a very expressive German word) is "unheimlich" meaning literally, not like home.

Now, it is, of course, up to me to show just how the machine should have been adjusted in order to do away with this trouble of having to stop the spindle. In addition I would remark that the Acme automatic does not, as a rule, work perfectly when running left-handed. This is because the indexing mechanism is so arranged that the last tooth on the indexing segment is adjusted to pull the cylinder a shade too far, then the dropping in of a taper pin sets it back so as to lock solidly. The spindles running left-handed assist in this pulling back. Now when the spindles run right-hand the tendency is to hold against the locking pin and very often the cylinder does not come back perfectly into place. This trouble I have often had when having to cut left-hand threads, especially on the 1¾-inch Acme.

Now for this thread-cutting problem. Set the machine so that the spindles run left-handed. Put a gear on the die-holder spindle to drive it right-handed so that the die runs 1/3 faster than the work. Start the die on as soon as the feed belt drops onto the slow feed pulley. Place a stop over the spindle in the right distance, so as to hold the die from running as soon as the correct length of thread has been cut and the die will run off by the action of the work, which is running left-handed. I believe the above explanation will convince Mr. Klein. I would now like to add one word more in regard to this placing so-called improvements on standard machines. It is a very nice thing to be experimenting with these different "ideas" especially when we stand in with the tool-room foreman and there is no job number to show how much attachments cost. But to be fair and honest with our employers we should first take the purchasing agent into our confidence, have a look through the catalogs and above all things, study the advertisements in the AMERICAN MACHINIST.

There is now a new four-spindle automatic screw machine built in England called "the simplex automatic," which threads screws as I have described. It cuts a most beautiful and perfect thread and in considerably shorter time than by the older method of stopping the spindle because the die runs on and off while the other tools are working, it not being necessary to run back slowly as by the older method.

Berlin, Germany. C. M.

Preserving the American Machinist

Several have told how they have kept the AMERICAN MACHINIST in vertical files, in scrap books, etc., but I think my way is much simpler, more economical of both time and money and better all around, so I will describe it. First I take and keep all magazines, at least all technical papers, on the theory that what is worth taking is worth keeping, and similarly what is worth keeping is worth keeping in good, proper shape. So I have all of my magazines bound in three-quarter morocco. This makes a very fine appearance, so that every volume is an addition to the appearance of the library. My usual method of having them bound is to put all of the ads from one copy at the back. By selecting a representative issue all of the advertising matter wanted is obtained.

But with the AMERICAN MACHINIST, no one issue gave me all of the good ads. There are many high-grade firms making several different machines and advertising them successively. Also many firms give in successive issues details of the parts of their machine. Similarly many others give illustrations of parts and the time required to perform the operations on these. Now all of these are of value and as much worth saving as is the reading matter. So I took them apart, separated out the reading matter, and then went through the ads. Most firms have a mortgage on some particular spot, so I went through the 26 issues and picked out all of the ads I wanted. Care is necessary in cutting the pages out, or you will increase the bookbinder's work instead of lessening it.

This may sound like lots of work, but I did all this for the last volume in three sessions of two hours each. Now having the full sets of ads required, I had these bound in at the back of the book. This added only 208 pages to the book, including the individual firms selected in addition to one complete set.

When this is all bound I have a fine, large, ornamental volume, and have all the ads that I want. I have no bother of cutting, piecing and pasting in a scrap book, or any vertical file with all the work of mounting, filing, indexing and cross-indexing, nor the consequent danger of losing a valuable page every time I take it from the file to look at it. Taken all around, I think this a good scheme.

Allentown, Penn. MORRIS A. HALL.

AMERICAN MACHINIST

Issued Weekly by the

Hill Publishing Company

JOHN A. HILL, Pres. and Treas. ROBERT MCKEAN, Sec'y.

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CIRCULATION STATEMENT

During 1907 *we printed and circulated* 1,151,500 *copies of the* AMERICAN MACHINIST. *Our circulation for July,* 1908, *was (weekly, monthly and European)* 110,000.

Aug. 6	33,000
Aug. 13	19,000
Aug. 20	18,750
Aug. 27	18,750

This paper reaches 33,000 *separate readers each month and* 18,750 *each week.*

None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

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A Training School for Consuls

The business inactivity at home has naturally turned the attention of our manufacturers to foreign markets. During the last few months many representatives of our American industries have taken extended trips abroad, in order to encourage their foreign business. Still such encouragement should not be sporadic and excited only by adverse conditions here. The foreign market should be assiduously cultivated. Our recent articles treating of trade opportunities in South America show only too plainly how those markets have been neglected by our manufacturers.

The statement is made that in many foreign countries the nations of Europe are more zealous in cultivating foreign trade than we are. A study of the distribution of exports as given in our South American articles leads us to believe readily that this is so. The foreign consular service of some countries, particularly England, Germany and France, is usually spoken of in the highest terms, and by comparison ours is considered but mediocre in personnel and effectiveness.

Able foreign consuls can be tremendously effective in promoting foreign trade. Therefore, the personnel of the foreign consular service is of direct interest to manufacturers who are looking to foreign markets. We must have our just share of foreign trade; a movement tending to aid that end by improving the training and equipment of applicants for the foreign consular service has been recently started by the George Washington University at Washington, D. C., and is well worthy of consideration.

This movement aims to develop and perfect a special university course to train young men for the consular and diplomatic field. A start has already been made, and has been quietly progressing since February, 1907. The purpose of this course is expressed in a phrase from the last will and testament of our first president, whose name the university bears, and is to teach young men the "principles of sound politics and good government." The needs of such a special course of training are set forth in the following quotation from the committee on foreign commerce and revenue laws of the New York Chamber of Commerce: "The extension of our trade in all parts of the world and the growth of our intercourse with foreign nations require a higher grade of education, and more ample preparations for the duties of our consuls and diplomatic representatives, as well as for other public officials." Doctor Hill, our embassador to Germany, has written of the timeliness of such an institution in these words: "The fact that no existing institution of learning affords an adequate opportunity for the study of the new questions which have arisen in connection with the commercial and political development of the country and of the world, has led to the suggestion that it is timely to consider the establishment of a special institution, having for its purpose the more thorough study of the resources of this and other countries, the means of production and transportation, the system of laws and forms of government and the methods of administration, together with the existing treaty relations, commercial and colonial enterprises, means of communications, modes of transacting international business, and the means of promoting peace and amity among nations."

This movement should command general sympathy and support. It is both practical and patriotic in the result that it expects to achieve. Its success, which will be one important factor in raising the effectiveness of our consular service, should be earnestly hoped for and striven for by American manufacturers. An opportunity for direct aid of the movement is offered to the business interests of the country through an appeal for contributions to the sustentation fund, which is being raised to carry on the work for the next five years, or until such time as an adequate permanent endowment can be provided for.

The Trend of Engineering Mathematical Training in Germany

For years technical educators have looked to the countries of Europe, and particularly to Germany, for ideas and methods to be used in the technical schools of this country. Such a course has been little short of aping. Discussions are frequent in regard to the needs of the engineer in mathematical training, and the technical press of the last few months has given us our share for this season.

It is, therefore, interesting to learn of the movements that are at work tending to change the mathematical training of engineers in the schools of Germany. A consideration of them may lead us to dodge some of the pitfalls into which she has fallen, and from which she is about to extricate herself. Professor Ziwet, in *Science*, distinguishes three distinct movements working for reform in the teaching of mathematics in Germany. The one that he speaks of first, we are pleased to note, originated with the great engineering society, Verein Deutscher Ingenieure, and has as its object the improvement of mathematical instruction in engineering colleges, by making instruction less abstract and theoretical and more practically useful to the engineer. Some of the leaders of this movement went so far as to demand that mathematics in engineering colleges should be taught by engineers and not by mathematicians.

The second movement has for its object the reform of the teaching of mathematics in universities. It aims to bring about a more healthy contact between mathematics

and applied science, instead of rushing every student through his courses, in order that he may begin original research in some particular line as soon as possible. The third movement has to do with the improving of the teaching of elementary mathematics, and is the most recent of the three.

Engineers who wish only the best for their profession and who take a real interest in young men, who one day will take their places, can be of direct aid to our great technical schools by giving advice and counsel in regard to such educational movements as we are considering. Professor Ziwet sums up the demands of the times as follows: "But I believe that the time has come in this country (America) when one or two years of general college study can be demanded as preparation for the professional engineering course, at least for those more able students who wish to obtain a thoroughly scientific preparation for their professional career."

The Annual Outing of the Boston Branch of the Metal Trades Association

The Boston branch of the Metal Trades Association held its annual outing on Aug. 18, inviting the members from Providence, Worcester, Fitchburg, and surrounding towns to enjoy with them, a delightful trip from Boston to Marblehead. The party numbered 61, including General Secretary Dingwall, of the National Association, and others prominent in the trade. Through the kindness of George Lawley, the private yacht "Sabrina" was secured, and the sail included a close inspection of some exciting sailing races held by the Quincy Yacht Club off Marblehead. Strange to say not a person paid toll to Father Neptune, all wearing the smile that don't come off from start to finish. President E. E. Bartlett, Mr. Lawley and others were given a rousing vote of thanks by the visiting members, and the aim of further personal interest and getting closer together was certainly accomplished.

New Publications

BALDWIN ON HEATING. By William J. Baldwin. Sixteenth revised and enlarged edition. 404 5x7-inch pages with many illustrations. John Wiley & Sons, New York, Chapman & Hall, London. Price $2.50.

Mr. Baldwin's original book, "Steam Heating for Buildings," appeared nearly 30 years ago. It is known to everyone connected with the industry to which it relates, and its merits are attested by the fact that it has gone through 15 editions. In so far as the original book related to the gravity-return system of heating, we observe but few changes, as very few have been called for, but as regards the use of steam by other methods, a general revision has been made. As now laid out, the earlier portions of the book relate to the permanent principles of heating apparatus, while the later portions relate to details and to such features of practice as are likely to change as time goes on. In its present form the book may be said to meet modern conditions as well as in its original form it met the conditions of its time and that is saying enough.

DRAWING INSTRUMENTS, THEIR USE AND ABUSE. By Walter G. Stephan. 108 4¾x7¼-inch pages, 74 illustrations in the text, indexed. McGraw Publishing Company, New York City. Price $1 net.

From the preface we gather that this treatise is intended primarily for teachers of drawing; if such teachers are not practical draftsmen we imagine that it may be helpful to them. It may be characterized as a detailed catalog of various tools that a draftsman might use, with specific recommendations of certain makes. It is thus good advertising for certain manufacturers. Beginning on page 7 is a list headed "Complete Drafting Equipment" and apparently recommended to the beginner in the study of mechanical drawing. This list contains no less than 38 items; if the beginner starts with all of them we are confident that there will be far fewer than this original 38 by the time he is a full-fledged draftsman working in a commercial drawing room. The tendency among expert draftsman is to use as few tools as possible, but to have those few wisely selected. Throughout, in describing the various instruments, great stress is laid upon the use of tests to determine their accuracy. The impression is given that the drawing tools made by all classes of makers are liable to be inaccurate, and that a geometrical method, or some other kind of testing, must be resorted to in order that the beginner or draftsman will not use a tool that is inaccurate. We do not believe that high-grade drawing instruments are as far wrong as this elaboration of tests would indicate. Should a Brown & Sharpe draftsman's protractor be tested by geometry and found to be incorrect we would still be skeptical enough to wager on the protractor rather than on the geometry. Nevertheless, the description of standard drawing tools, their uses and their abuses, is well written and the book should be of service to the beginner in the study of mechanical drawing.

THE STEAM TURBINE. By Robert M. Neilson. Fourth edition, revised and enlarged. 604 5¾x9 inch pages with 387 illustrations; Longmans, Green & Co., London and New York. Price $4.20.

One of the first works of any pretention upon the steam turbine was that of Robert M. Neilson, which appeared in 1902. The eager demand for information and the rapid development of the subject have resulted in the absorption of three editions of this work, each extensively revised, and the fourth edition, increased to a volume of more than double the size of the original, is now under review. The author's aim has been to render the subject intelligible to the average engineer who has a fair but not necessarily a very extensive scientific training. His work commences with an easily understandable explanation of the application of the velocity diagram to determining the relative velocities with which the steam enters and leaves the bucket, with the fundamental formula for the change of momentum and the work done. This is incidental to an exposition of the fundamentals and a setting forth of the definitions necessary to an understanding of the later chapters. There follow 55 pages of historical account, enough to place the reader in touch with the development of the turbine and to turn the investigator from paths which have been already explored. The third chapter dealing with "The Conversion of the Heat Energy of Steam into Kinetic Energy," is the most abstruse portion of the book and one of the few portions in which the calculus is used. The next chapter classifies and compares the various types of turbine. Chapter V treats of "Losses and Efficiencies." Seven chapters are then devoted to the description of existing types of turbine, not generally but in detail. The effects of pressure, superheat and vacuum are then considered and a chapter devoted to electric generators as adapted to turbine drives. Some of the important turbine tests are recounted and a number of the notable turbine stations, both American and European, described. The concluding chapter treats of "Ship Propulsion by Steam Turbines." Appendices contain tables of useful information and a complete list of British patents relating to turbines.

Personals*

Forest E. Cardullo, who formerly held the professorship of practical mechanics at the Syracuse University, has recently accepted the chair of mechanical engineering at the New Hampshire State College.

J. Henry Sirich, Jr., has recently associated himself with the power department of the Bethlehem Steel Company. Mr. Sirich was formerly connected with the Westinghouse Machine Company as turbine engineer.

Kibiler Brothers, superintendent and foreman, respectively, of the Wisconsin Engine Company, Corliss, Wis., are soon to engage in the manufacture of gas and gasolene engines for their own account, a factory for which purpose is now in the course of construction.

*Items for this column are solicited.

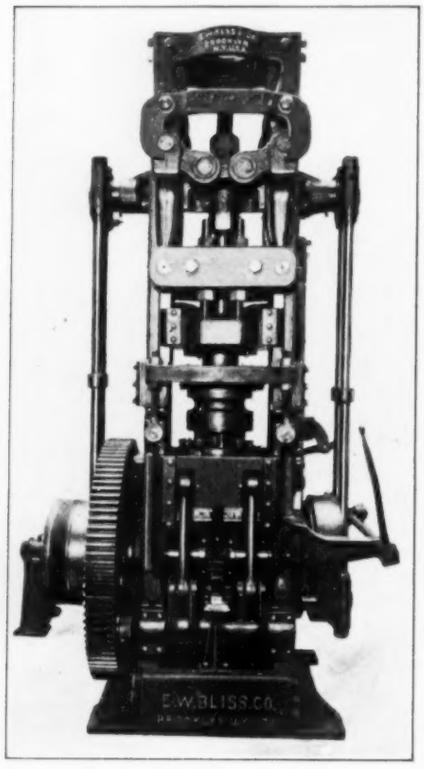
New Tools and Machine Shop Appliances

Showing New Ideas in Machine Shop Equipment That Make It Possible To Do Better Work at a Reduced Cost

THE LATEST INFORMATION

Triple Action Drawing Press

The triple-action drawing press shown herewith is a development of the Bliss toggle drawing press, which is used for drawing all kinds of sheet-metal goods.



A TRIPLE-ACTION DRAWING PRESS

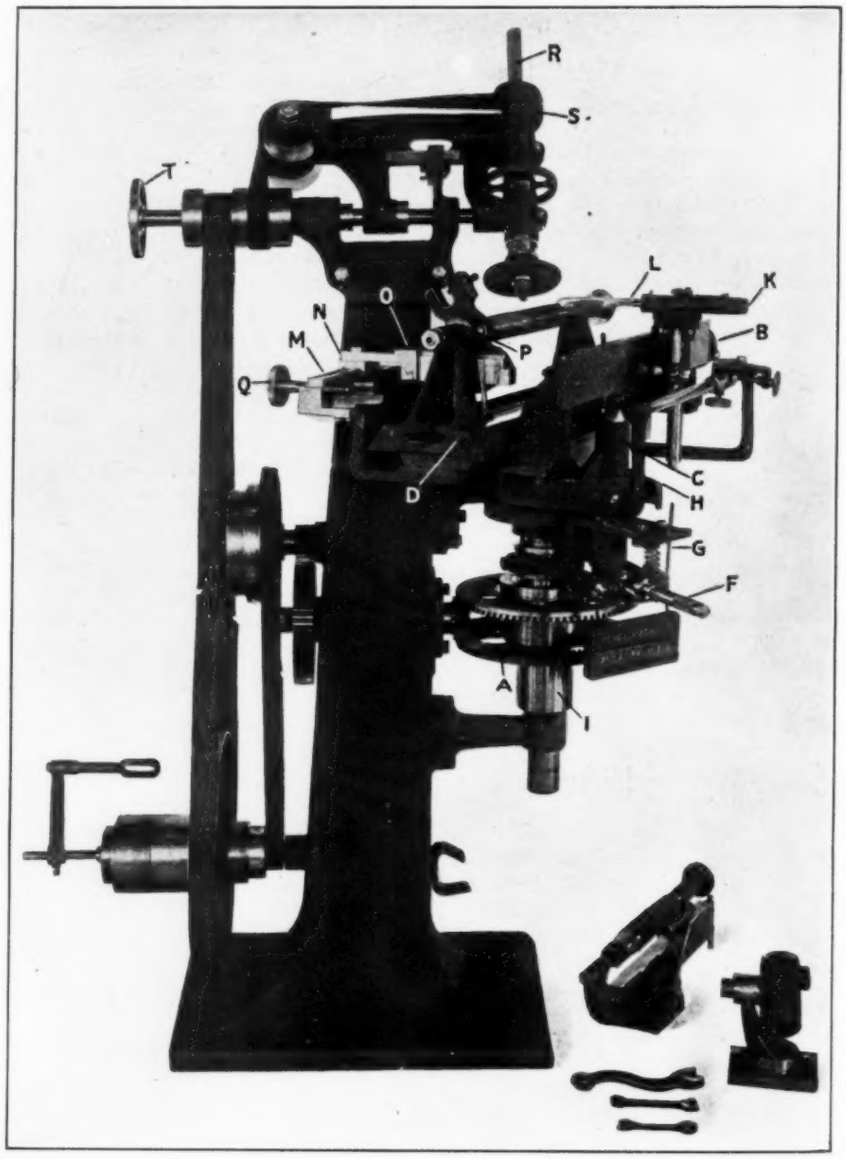
It is especially useful for drawing deep, seamless shells and similar work. In addition to the plunger, it has two slides, each having an independent dwell, so that work can now be done in one operation, which has hitherto required two. This does away entirely with handling or annealing after the first operation, as the second follows the first so closely, making the second draw while the metal is still warm from the first operation.

The press shown will receive a blank 25 inches diameter No. 24 U. S. standard gage maximum thickness, and a drawing punch up to 16 inches diameter, and will draw and lift out up to 9½ inches.

The lower table, carrying the dies with the blank, is raised to meet the stationary blank holder by means of the toggles, then the first-operation punch comes into action and makes the first draw. The first punch then becomes the second-operation blank holder, and the center plunger carrying the second-operation punch acting in turn, now draws the blank through the second-operation die. The lower table carrying dies then recedes, and this, in conjunction with the lower positive knock-out, places the drawn shell free on top of the die ready for removal. The press is of very compact construction, and occupies no more room than any double-action press of the corresponding size for the second-operation shell. The flywheel is 54 inches in diameter by 8 inches face, weighing 2300 pounds, and the total weight of the press is approximately 60,000 pounds. It is made by the E. W. Bliss Company, Brooklyn, N. Y.

Automatic Cutter Grinder

The illustration shows the Gleason cutter grinder in its latest form, equipped with table feed and rotary cutter feed. In this design the original feed motion for the table is done away with, there being substituted a rack and a gear with a long hub, on which hub, and running in opposite directions, are two large bevel gears *A*. The inner hubs of these gears are



AUTOMATIC CUTTER GRINDER

provided with ratchet teeth, and between the hubs there is keyed to the long hub of the gear a sliding collar with each end toothed; this gives reverse motion to the table, and uniform speed throughout the entire stroke of 16 inches. The length of this stroke can be varied by turning the hand wheel *B*. This turns a right- and left-hand screw (not seen in the engraving), on which are two reversing dogs that are brought closer together or separated, as the case requires. Through the medium of an upright shaft *C*, having a double crank at the upper end, the dogs impart the necessary motion to the clutch lever to reverse the travel of the table. The clutch itself is covered by the separating collar *E*, between the bevel gears *A*.

To bring the table to a dwell or stop, the lever *F* is brought to central position, when it locks itself at *G*, as seen. The saddle and all connected with it, above the line *H*, is raised and lowered by means of a screw, miter gears and handwheel, of the bed; this is controlled by the handwheel *Q*.

The wheel spindle *R* has a four-wheel drive which allows it to be set in any position, from horizontal to perpendicular. The spindle head *S* has a 3-inch horizontal movement by means of screw *T*. This machine grinds lengths up to 16 inches and diameters to 10 inches. It is built by the Olney Machine Works, Philadelphia, Penn.

A Large Gear Cutter for General Work

This machine has been designed to accommodate a large range of work, including spur, bevel, skew and face gears, all of which can be cut entirely automatically; to rough out bevel gears preparatory to finishing on a bevel-gear planer, as well as to afford the jobbing and repair shops a machine for finishing bevel gears by the milling method, and yet without limiting the capacity of the machine for spur-gear work.

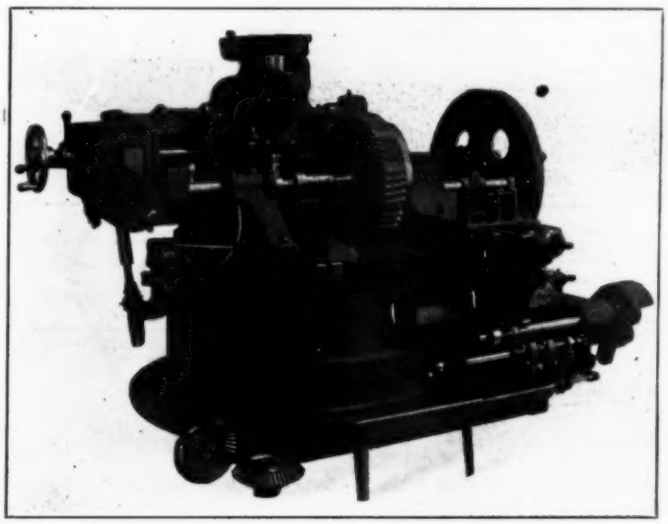


FIG. 1. NEW GEAR CUTTER AND ITS WORK

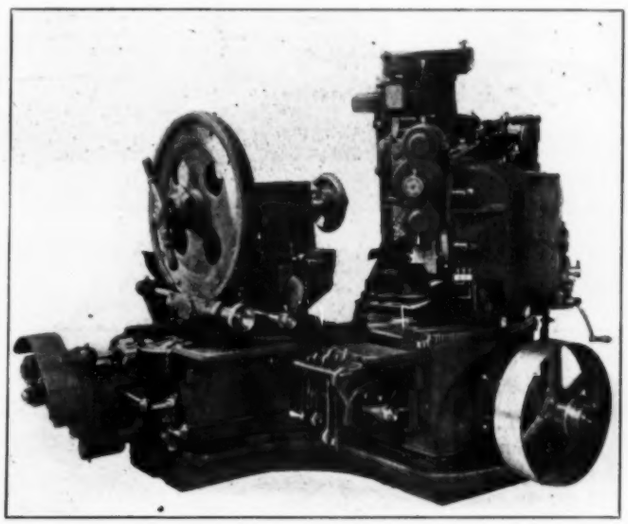


FIG. 2. THE BACK OF THE MACHINE

It has a capacity of 48 inches diameter and 10 inches face, and will cut 3 diametral pitch in steel and 2½ diametral pitch in cast iron. Heavier pitches can, of course, be cut by taking stocking-out cuts, one of the first of these machines cutting two diametral pitch in steel as regular work, in this way. The machine uses a rotary milling cutter, although the general appearance of the machine itself is similar to that of the now accepted types of bevel-gear planers.

The method employed in cutting the large variety of gears above named may be very readily understood from the front view of the machine, Fig. 1. This shows a cast-iron wheel in place on the work arbor, the teeth including spur teeth, right- and left-hand skew teeth, and face-gear teeth. These were all cut automatically. The gashed worm wheel was cut by feeding the blank into the cutter by hand. It may be explained here that skew teeth are used in many cases instead of hobbed worm-wheel teeth, for meshing with a worm. The miter gears on the floor were cut entirely automatically, one having been roughed out only with one central cut, and the other being finished in two side cuts.

The work head is adjustable in two directions. One accommodates the different diameters of blanks and sets the depths to be cut, while the other is at right angles to the first, and is used so as to accommodate bevel gears and pinions with various lengths of hub. This is also used to set the depth when cutting face gears. Adjustable dials are provided on both screws, graduated to read to thousandths of an inch. The long screw, that which adjusts the head for different diameters of blanks, has a square on both ends for convenience in setting, so that it may be operated at either end.

The angular adjustment required for cutting bevel gears is made by means of the cutter-carriage support. This is adjustable through an angle of 90 degrees, in a horizontal plane, and is pivoted about the center of the machine. It is secured to the bed by means of bolts in the circular T-slots. For making the angular adjustment a worm is provided, engaging the circular rack which is secured to the bed. The worm carries a dial graduated to read to minutes of a degree, each degree being one turn of the crank.

The stanchion is equally rigid at every angle, whether set for spur gears, bevel gears, or even when adjusted through the entire 90 degrees for face gears. The swivel slide, carrying the cutter head, is adjustable on a vertical plane, being pivoted about a central trunnion. This slide is operated by means of the vertical screw, and graduations indicate the angle at which it is set. By swiveling this slide, the cutter-carriage, which is mounted upon it, is made to

not seen in the illustration, as they lie behind the bed, but within convenient reach of the operator. The saddle has a rotary adjustment around the center column *I* from 0 to 90 degrees.

The rotary feed *K* in principle is the same as previously illustrated, but mechanically is somewhat changed. The pawl bar *L*, having three slots or grooves instead of one, allows the pawl to engage on the top, or from either left- or right-hand side on vertical or horizontal cutters.

The spiral attachment *M* seen at the left of the machine, is quite simple in construction, having an angle bar with a sliding crosshead *N* attached to a rack *O*, which engages with the pinion *P*, and, as the table travels, a reciprocating motion is given to the rack *O*, while this in turn gives a rotary motion to the cutter. Of course the amount of spiral thus obtained depends altogether upon how much the angle bar is out of parallel with the travel

travel in a path at an angle with the axis of the work spindle. This adjustment is used for cutting right- and left-hand skew gears, and for taking side cuts on bevel gears, thereby obviating the necessity for rolling the blank. The rolling method of cutting bevel gears may be used, however, when desired, and the indexing worm is, therefore, graduated, to facilitate this adjustment. The swivel slide is also used to set the cutter at the angle of the worm thread when gashing worm wheels.

The rotary cutter is mounted upon the vertical cutter arbor, the spindle bearing being adjustable vertically, to set the cutter central. A dial indicates the offset of the cutter, when taking side cuts on bevel gears. The lower end of the cutter arbor is supported by an outboard bearing. An outside support is also furnished for the work arbor, as shown in Fig. 1. This accommodates wheels up to the full capacity of the machine. The support is easily removed. Rim rests are provided to support the rim of large gears against the thrust of the cutter. A face-plate is also furnished, with jacks and drivers to positively secure and drive large wheels. The cutter spindle and work spindle have taper holes, and each is provided with a draw-in bolt, to draw in and force out the arbors positively.

The drive is from a single pulley running at constant speed, supplying power for the entire machine, and a constant-speed motor drive is used when desired. The driving pulley runs on the cast-iron sleeve, which is bolted to the bed, thus relieving the shaft of the pull of the belt. The cutter drive is obtained by means of spur gears, operated by change gears for obtaining the different rates of cutter speed, these being arranged in geometrical progression and giving ample power. The feed of the cutter carriage is changed by gears in similar manner, but the return of the carriage is at a constant high rate of travel, which is independent of the speed or feed of the cutter. The cutter speeds and feeds are also independent of each other.

There is an entire absence of ball joints and telescopic shafts in the drive train. The driving shafts run at constant speed, all changes being made at the last drivers. This reduces vibration under heavy duty, there being no shafts under excessive strain, whether the cutter is running at a high or low speed. The cutter carriage is of exceptional length and travels on long guiding surfaces. The cutter spindle is in the center of the length of the carriage, which prevents the lifting or gouging tendency of the cutter, when starting in each tooth.

The thrust bearings for the feed-screw are placed at each end, so that the screw is under no compression strain during either the feed or the return of the cutter carriage, reducing vibration and chattering, as the screw operates under tension only. The bearings of shafts and spindles which operate in a vertical position have spiral oil grooves cut of the opposite hand to which the shaft runs, to retard the downward flow of the oil. Felt wipers are arranged on all the plane-bearing surfaces, to keep dirt and chips out, and hold the oil in. This is built by the Eberhardt Brothers Machine Company, Newark, N. J.

A Still Larger Grinding Machine

This is perhaps one of the largest cylindrical-grinding machines ever built, having a capacity of 20 inches in diameter and 192 inches between centers, while the base is 30 ft. long. The 20-inch machine is built in eight sizes, taking in from 96 to 264 inches between centers, with variations of 24 inches between each size. In the largest machine the base is 42 feet long.

The details of construction are similar to the regular sizes of the Norton machine, and this particular line has been designed for grinding long and heavy shafts for stationary engines, marine work, heavy spindles and other work of a similar nature. Permanent adjustable wedges are used for securing and maintaining perfect alinement of the beds, the base is unusually heavy, the ways are wide and the oiling rolls are placed nearer together than is usual in order to insure long life and continued accuracy. The photograph shows the machine driven by overhead work, but it is also supplied with self-contained electric-motor drives if desired. It weighs complete about 15 tons.

There is no provision for grinding taper work, as it is very seldom called for on heavy work of this class and would add complications, which are unnecessary and undesirable. There is, however, an adjustment on the foot-stock to correct the

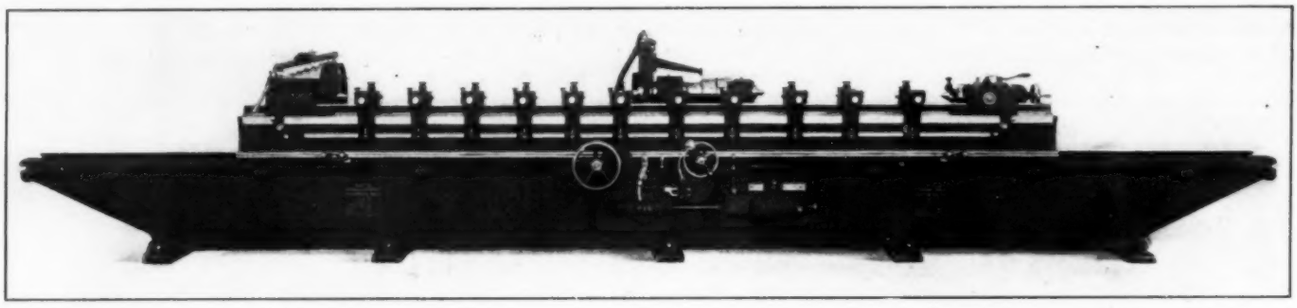


FIG. 1. CYLINDRICAL GRINDER THAT WILL TAKE WORK 20X190 INCHES

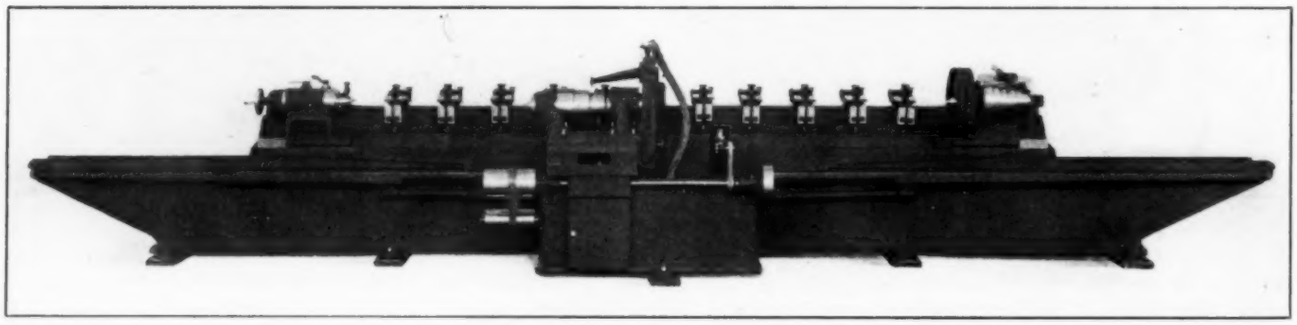


FIG. 2. REAR VIEW OF LARGE GRINDER

alinement of centers in case of wear. The grinding wheel is furnished in widths varying from 2 to 4 inches by 24 inches in diameter, and the machine will utilize 20 horsepower on the heaviest work. It is built by the Norton Grinding Company, Worcester, Mass.

A German Automatic Gear-cutting Machine

A new model automatic gear-cutting machine shown as No. 18A, Model III, is now being built by Ludwig Loewe & Company, Berlin. The two accompanying half-tones show the front and rear views of one of these machines.

Referring to these illustrations the usual method of fastening the index wheel to the work spindle by means of a quill has been done away with. The work spindle is of machinery steel and has a forged flange 11 to provide a broad bearing against the index wheel 10, thus forming a strong, ample mechanical connection. The drive of the work arbor is through a large milled slot 6 in the end of the work spindle 5. A milled projection on the arbor enters this slot and the arbor is fastened in position by means of two screws. This work spindle can be fixed in any position desired by means of

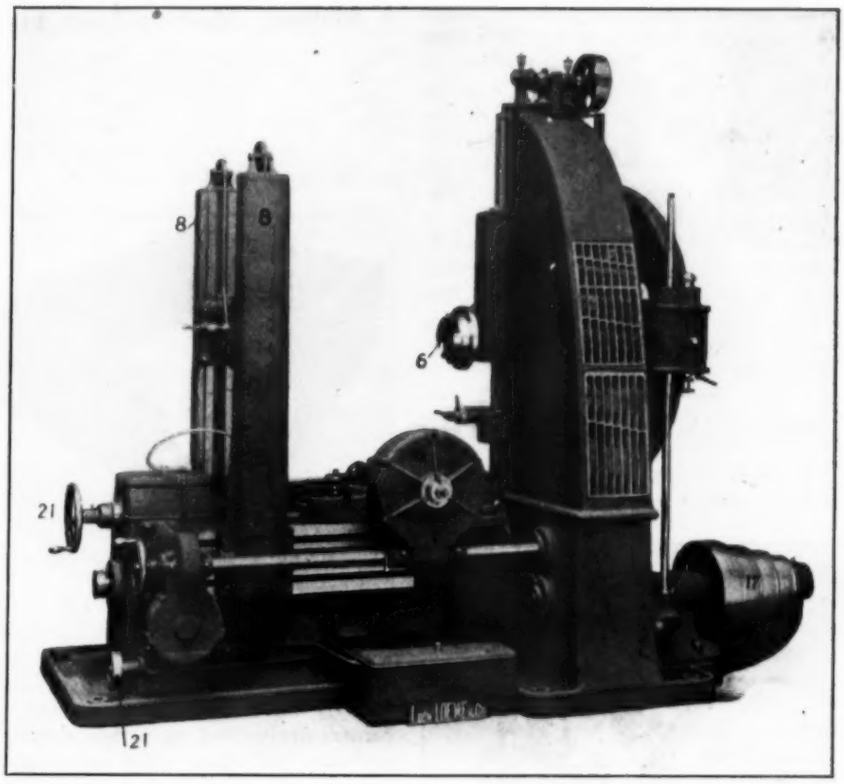


FIG. 2. REAR OF GERMAN AUTOMATIC GEAR CUTTER

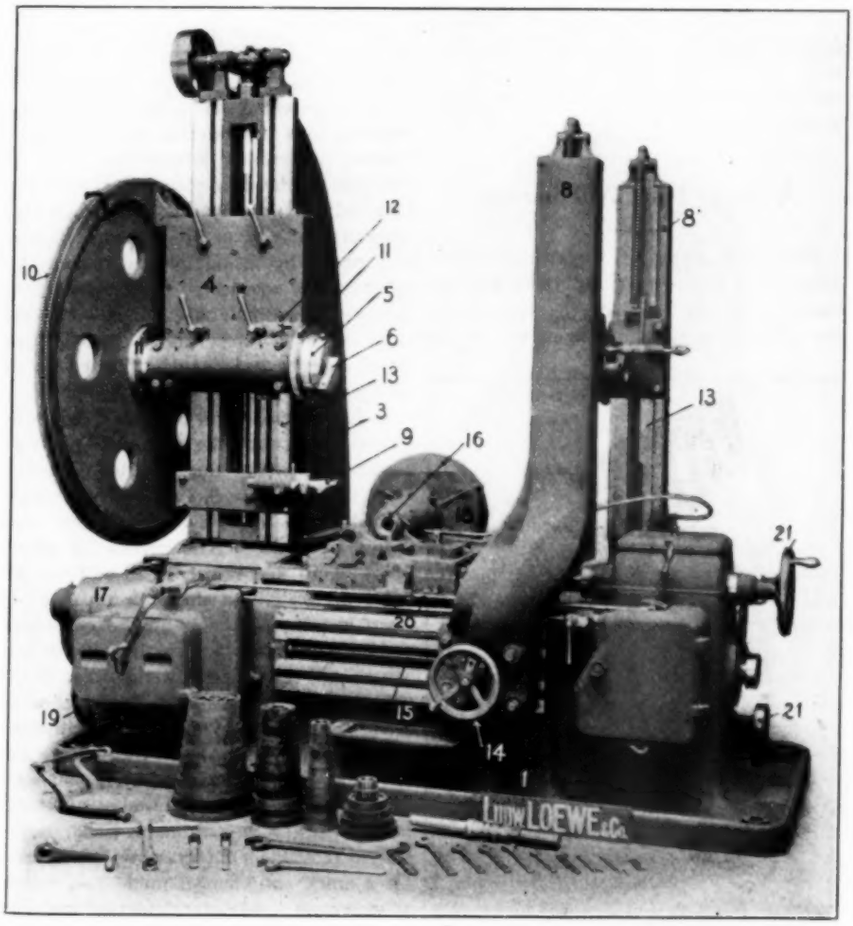


FIG. 1. FRONT VIEW OF NEW GERMAN AUTOMATIC GEAR CUTTER

the locking bolt 12, so that in tightening or loosening the nut on the work arbor the strain cannot be brought upon the teeth of the index wheel to its injury.

The outboard supports 8 are provided with the same graduation 13 that is placed on the work-spindle slide 4, so that the position of the work arbor parallel to the ways of the cutter slide is always insured. Both cutter slide and outboard bearing can be fastened rigidly to the frame of the machine. Movement of the outboard bearing along the bed is obtained through the handwheel 14 and screw 15.

The cutter spindle 16 is driven through a four-step cone 17, intermediate gears and a worm 18. The cutter arbor is driven by means of a milled slot in the end of the cutter spindle and is held in place by a draw bolt.

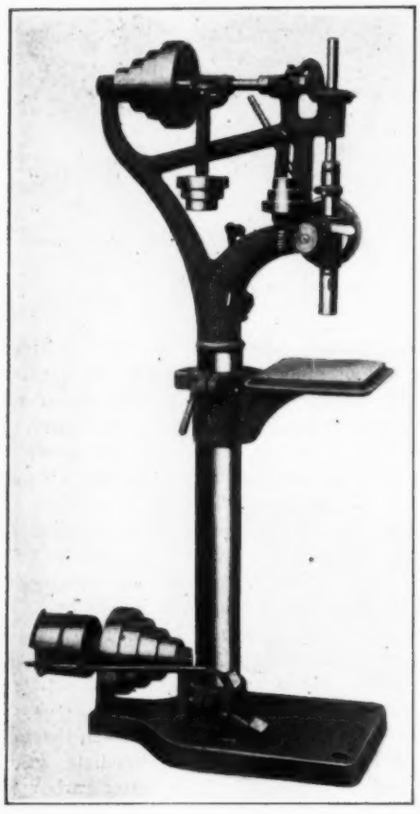
The feed is taken from the main driving shaft through a worm gear, change gears and a worm wheel to the cutter slide. The return motion of the cutter slide is constant and independent of the cutting motion. It is driven by a special belt pulley 19 through a long shaft and spur gears. A friction clutch controls this return motion. The tripping device is carried on the cutter slide and is actuated by means of stops 20 of well known construction. The cutter slide can be moved to any position by the handwheel 21.

The automatic indexing is independent of the motion of the cutter spindle and of the feed of the cutter slide. This mo-

tion is taken from the belt pulley 19, which also drives the mechanism for the return of the cutter slide. Motion is transmitted through a worm wheel to the indexing flange and from thence through change gears, bevel gears and a worm wheel to the indexing wheel 10. The indexing, of course, takes place at the moment that the return motion of the cutter slide is completed and the cutter slide cannot move until the indexing is completed, thus false indexing and defects from that source are eliminated. The maximum work capacity of this machine is 80 inches in diameter and 14 inches face.

Sensitive Drill with Power Feed

A slight departure in the method of securing power feed has been adopted by

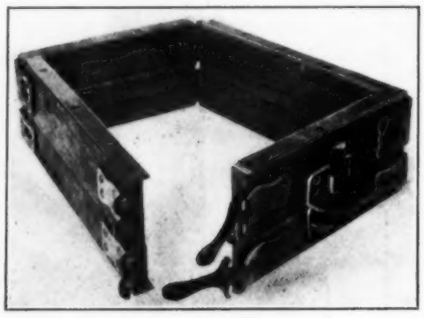


POWER FEED SENSITIVE DRILL

the Hoefer Manufacturing Company, Freeport, Ill., in their new line of lever feed or sensitive drills. As will be seen, the feed is taken through on a worm on the main drive shaft, and the feed belt from this cone drives a cone having another worm, which engages with the worm wheel directly on the pinion shaft for feeding the spindle. This worm is thrown in and out of mesh by the small lever shown, which is so arranged that the trip placed on the spindle comes down against this lever at any desired point and automatically throws the feed worm out of gear. This does not in any way interfere with the regular lever feed of this drill, and the arrangement seems to make a very desirable combination.

A Molding Machine Snap Flask

The new flask for machine molding, recently put on the market by the S. Obermayer Company, of Cincinnati, Chicago and Pittsburg, combines every good point needed in a flask of this kind.

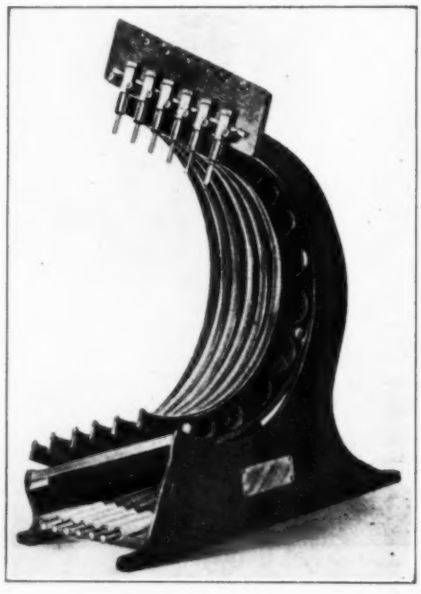


MOLDING MACHINE SNAP FLASK

It is made of 1⅛-inch kiln dried Cherry, which is grooved on the inside, with the corners machine-locked. It is bound top and bottom with iron bands, securely screwed to the flask, and the corners are welded solid, thus making a perfectly rigid flask. The corner plates are of extra heavy malleable iron. The hinges are also malleable with machined bearings the entire length of the flask. The hollow V-shaped pin and guides insure close contact and permit the sand to drop between the pin and the flask. The snap used on this flask is simple, strong and efficient, and made either in the hook or lever type.

A Set of Huge Micrometers

Will say that this set of six micrometers cover sizes between 13 and 18 inches, inclusive. In the base of the rack there are grooved boards holding a set of six



A SET OF LARGE MICROMETERS

end measures. These end measures are 7/16 inch in diameter and vary in length by 1-inch steps. These are similar to the regular micrometers except for the size of frames, and are made by the J. T. Slocomb Company, Providence, R. I.

A Rust-proof Finish for Measuring Tapes

All users of measuring tapes know the annoyance and damage that occurs when rust accumulates, either in spots, or in solid patches, on a steel tape and renders the graduations indistinct. To prevent this the Keuffel & Esser Company, of New York, are now using a finish on steel tapes which is said to effectually prevent their rusting, either from dampness or from handling. This is known as their "Keco" finish, and is a brilliant covering, which is dark enough to show the graduations very plainly. It makes a handsome looking tape and will be appreciated by those who have had ordinary tapes ruined in this way.

The Use of Plotted Charts in Estimating

By A. K. Reading

In engineering offices, where estimating, making bills of material and other calculations are made which deal with the weights of standard plates or shapes varying only in their length, and which recur day after day, a great saving of time can be made by using plotted curves. If plates, say, 10 inches, 11½ inches, or 14 inches in width, and ¼ inch, 5/16 inch, and ⅜ inch thick, are commonly used, nine straight lines can be plotted on one sheet of co-ordinate paper, using the abscissas for the length in feet or inches and the ordinates for the weight in pounds.

This same procedure can be carried out for beams, channels or any other shape which each individual estimator meets most frequently. The curves are easy to plot, as all that is needed to be done is to find the weight of the plate or shape for two lengths, point off on the co-ordinate paper and draw a straight line through them and the weight for the other lengths can be seen at a glance. This method can also be used in the cost department in making up labor cards. By plotting lines for the different rates per hour on which the abscissas show the number of hours a man works, the ordinates will indicate the wages due. The use of plotted curves is a quick and efficient method of figuring for certain kinds of calculation and eliminates much of the tediousness and inaccuracy resulting from oft-repeated and intricate arithmetical work.

A New Welding Process

A. K. Schaap, of the Schaap Automobile Company, 344 Cumberland street, Brooklyn, N. Y., has, after 35 years of experimenting, discovered a process of autogenous welding that may be destined to revolutionize this industry, owing to its simplicity and consequent cheapness.

The process is patented and consists of combining a blast of atmospheric air, at 1½ pounds pressure per square inch, with gas, such as is done in the bunsen burner. When the flame from this blast has been regulated so it will be at its highest efficiency, a blast of air, from the air compressor, is turned on that has a pressure of from 30 to 50 pounds per square inch, and this combination immediately raises the heat of the flame to about 4500 degrees Fahrenheit.

While Mr. Schaap has done most of his experimenting and work with city gas, he has also conducted some tests with acetylene, naptha and hydrogen gas, and these have given equally good results, and no doubt natural and producer gas can be made to work just as successfully with this double-air blast. The mixture, or combination, is made in a special burner, which is of the bunsen-burner type, with an addition to take care of the extra air blast. The rest of the apparatus needed consists of the necessary piping from the gas mains or sources of supply, and the piping and tanks necessary to get the two blasts of air from the air compressor, with which most shops are equipped.

With this welding process cast iron and aluminum are being successfully welded by Mr. Shaap, these metals being very difficult to weld by any of the other processes, and he is also welding cast iron to steel. Steel, brass, bronze, copper, and the other metals that are being welded commercially by the oxy-acetylene, oxy-hydrogen and other processes are being welded equally as well with this. One stunt that was done by Mr. Schaap was to place a broken piston ring on a fire-brick in a pail of water, so that the water would just cover the ring, and then weld the joint. This stunt showed that there was more heat than was absolutely needed in the blast, as the welded cast-iron joint was about ¼ inch square, and only about one minute was consumed in making the weld, when surrounded with water.

The amount of gas used in this welding process is claimed to be very small, and Mr. Schaap has put in piping that conducts it to all parts of the three floors of his public garage. Thus, by connecting the burner the men are ready to make a weld in any part of the shop, and much of the work which was done on the machines with expensive machine operations is now done by welding.

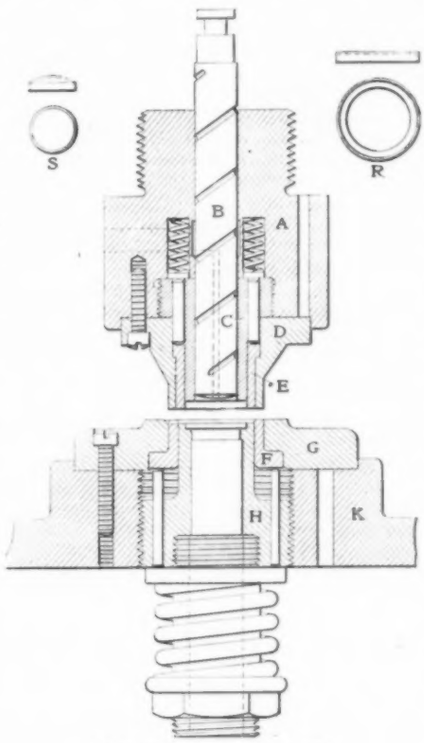
Just why two blasts of air traveling at different speeds, and combined with gas, should operate on metals as this does, has not yet been satisfactorily solved, but it is no doubt due to the fact that oxygen and hydrogen are combined in just the right proportions, and an oxy-hydrogen flame is produced. In welding the cast iron with this, the oxygen which forms in the joint is removed before the action ceases and the metal is better at this point than on either side of the joint. Likewise the oxides in the other metals welded are burned out before the metal is left to solidify.

E. F. L.

Producing Two Different Pieces at Each Stroke of the Press

By A. J. O'Mattey

The illustration shows a sectional view of a punch and die used in a double-action power press of the conventional type, which will produce at each stroke of the press two distinct pieces *R* and *S* from russia iron 0.0126 inch thick. Rim *R* is used for a price tag; in a subsequent operation cardboard is inserted and the side of the rim is closed in to retain it. The shell *S* was used as a back for a celluloid button. Part *K* is the die holder made of machinery steel recessed on the upper surface for the outside blanking ring *G* and is threaded on the interior. In it six equidistant holes are drilled, three being tapped to receive the blanking-ring screws, the other three holes are to allow the insertion of pins to drive out *G* when necessary to do so; also two tapped holes not shown for the admission of screws to prevent part *H* from turning. The punch holder *A* is made of tool steel octagonal shaped and left unfinished for wrench. It is recessed for the outside blanking and drawing punch *D* and threaded for the inside blanking punch *C*. Four holes are drilled in it for springs which operate the shedder *E* by means of four tool-steel hardened pins. The center was bored for the drawing punch *B*. The annular groove connected with the horizontal hole is for the escape of compressed air caused by the descent of the drawing punch. The drawing punch *B* is made of tool steel; spiral grooves were cut in it for proper lubrication, axial and horizontal holes were drilled for the exit of air. The upper end was made to suit the forked key in the plunger; it was then hardened and ground. The blanking ring *C* is made of tool steel, hardened and ground, and is fastened to the die holder by three fillister-head screws. Parts *C D H* are the most particular, as the success of the die depends on them. They were first bored and turned to within approximately 1/16 inch of size, and then packed in charcoal in an iron box and kept at a red heat for an hour, then left in ashes to cool; this was to overcome any tendency to twist in hardening. These parts were then finished, allowance being made for grinding on the working surfaces, after which they were heated to bright red and quenched in oil. These parts were drawn to the requisite hardness in oil and ground to finished size. No difficulty was ever experienced through the breaking in hardening or operation of punches treated in this manner. The metal was obtained in sheets 14x20 inches, and is fed through the guide against a knife-edge stop, not shown. The punches descend and punch *D* blanks and forms the metal over part *H*; by continuing *C* it blanks out the center of the rim *S* and holds it under slight pressure on the projection in *H*. The drawing punch then descends, forcing the blank through the die. When the punch descends it strikes the back edge of the die, thereby stripping it off the punch and drops it in the box directly under the press. In the meantime the rim *R* is forced off the part *H* by the shedder *F* and prevented from adhering to the punch by the shedder *F*. The rim was blown from the face of the die into a receptacle at the rear of the press by means of compressed air.



THE WORK AND THE DIE

National Society for the Promotion of Industrial Education

Announcement is made by the above society of its next annual meeting, which will be held at Atlanta, Ga., November 19, 20 and 21. An elaborate program is scheduled and some notable speakers are down for what promises to prove highly interesting and effective addresses.

Business Items

The Independent Pneumatic Tool Company, Chicago, has appointed H. W. Petrie, 131 Front street, West Toronto, Ontario, exclusive agent for Canada.

The Wilson-Snyder Manufacturing Company, of Pittsburg, Penn., builders of steam pumps, has arranged with S. B. Whinery, 95 Liberty street, to represent them in New York and vicinity.

The Schaeffer & Budenberg Company has sold its plant at Foxboro, Mass., to the Industrial Instrument Company, which was recently organized by B. R. Bristol, formerly of Bristol Company, Waterbury, Conn. The Standard Gauge Manufacturing Company, Syracuse, N. Y., will operate the plant for the manufacture of gages, recording instruments, etc., and the property will be deeded to this company by the Industrial Instrument Company, the same interests controlling both concerns.

Trade Catalogs

Norton & Company, Worcester, Mass. Booklet illustrating and describing manufacture of alundum. Complete story of the process.

National Tube Company, Pittsburg, Penn. Booklet describing and illustrating mechanical properties of Shelby seamless steel tubing.

Montgomery & Company, 105 Fulton street, New York City. Catalog of machinists' tools. Paper, illustrated, 272 pages, 2¼x6½ inches.

Fort Wayne Electric Works, Fort Wayne, Ind. Bulletin No. 1107 describing standard A.C. single-phase switchboard panels. Illustrated, 12 pages, 8x10½ inches, paper. Bulletin No. 1108, describing multiphase revolving-field belted generators, form A. Illustrated, 8 pages, 8x10½ inches, paper.

General Electric Company, Schenectady, N. Y. Bulletins No. 4601, illustrating and describing automatic voltage regulators for alternating current generators. 14 pages, 8x10½ inches. Bulletin No. 4602, on automatic voltage regulators for direct current generators. Illustrated, 10 pages, 8x10½ inches. Bulletin 4609, describing lamp testing Watt indicator type, L. Illustrated, 2 pages, 8x10½ inches.

Business Opportunities

The Crane Company, of Chicago, is soon to begin construction of a large plant in Pittsburg, Penn.

The California Industrial Realty Company, Riverside, Cal., is to construct a large iron foundry.

The Independent Pole and Shaft Company, of Huntingburg, Ind., will erect a large plant in Louisville, Ky.

The Steele & Johnson Manufacturing Company, of Waterbury, Conn., are to erect a new factory building.

The Salina Foundry and Manufacturing Company are soon to build a large uptodate cement factory building.

Work on the large new foundry and erecting shops of the Industrial Works of Bay City, Mich., is soon to be started.

Construction of the Stanley Rule and Level Company's new factory at New Britain, Conn., is soon to be started.

It is reported that the Whitman-Barnes Manufacturing Company is to rebuild its plan at St. Catharines, Ont.

Contract has been let by the Johnston & Jennings Company, Cleveland, O., for erection of a new machine shop.

A large addition is soon to be added to the Wilcomb Machine Company's knitting-machinery plant at Norristown, Penn.

The Pacific Malleable Castings Company, Pasadena, Cal., will shortly begin the construction of new factory buildings.

The Waterbury Manufacturing Company, Waterbury, Conn., has two large additions to their factory under construction.

A new company under the name of the Middletown Foundry Company is to commence work on a large plant at Middletown, Penn.

An addition of a core room is being made to the plant of the Poughkeepsie Foundry and Machine Company, Poughkeepsie, N. Y.

The Otis Steel Company, of Cleveland, Ohio, is to erect a large steel-plate mill, which will manufacture steel plate up to 152 inches.

The Consolidated Iron Works Company, Santa Anna, Cal., have taken steps toward the erection of an uptodate machine, pattern shop and foundry.

A new factory building is to be constructed this coming winter for the manufacture of cotton-picking machines by the Vacuum Cotton Picking Company, St. Louis, Mo.

The Charlestown (S. C.) Paper Box Company will establish plant to be operated by electric power. W. S. Lammeau and E. H. Schirmer, Jr., organizers.

Worth Bros. Company, Coatesville, Penn., has commenced the construction of blast furnaces for the production of pig iron. About $1,500,000 will be expended.

The Southern Kansas Railway Company of Texas will erect roundhouse and machine shops at Canadian, Texas. C. A. Morse, Topeka, Kan., is consulting engineer.

The Northwestern Iron Company, of Milwaukee, Wis., has increased its capital stock to $1,000,000 and will make extensive improvements at its plant in Mayville, Wis.

The Rockingham (N. C.) Foundry and Machine Company has been organized and will establish a general foundry and machine works. W. A. Biggs will be general manager.

The Straubel Machine Company, Green Bay, Wis., expect to occupy their new plant now building, where they will increase their output of marine and gasolene engines.

It is reported that the Chesapeake & Ohio Railway Company will build repair shops at St. Albans, W. Va. T. I. Cabell, Richmond, Va., engineer maintenance of way.

The organization of a company to establish a brass foundry at Rome, Ga., is contemplated. Particulars can be had of the Manufacturers and Merchants Association of Rome.

The Frisco Iron and Steel Company, Frisco, Beaver county, Penn., a new concern that is to manufacture iron pipe from scrap metal, is to erect a large plant for this purpose.

Bull Automatic Tipple Company, Knoxville, Tenn., has been incorporated to manufacture mining car wheels, tipples, etc. Jos. Vasey, C. S. Oldroyd and others, incorporators.

Work on the new plant of the Roller-Smith Company, Bethlehem, Penn., manufacturers of electrical instruments and equipment, has been started and is to be completed in three months.

The Carson Brick Company, Charlotte, N. C., whose plant was recently burned at a loss of $75,000, will rebuild. J. E. Carson, president of the concern, is engineer and architect in charge.

A new machine shop and foundry is under construction for the Goldschmidt Thermit Company, 90 West street, New York City, which will adioin their present plant in Jersey City.

The Block Light Company, with headquarters at New York City, are to construct a plant at Youngstown, Ohio, for the manufacture of Welsbach gas burners, mantels and Bloch light burners.

The Boring Cash Register Company, Dayton, Ohio, has been incorporated with $50,000 capital by Geo. N. Barr, A. N. Burkhart, C. M. Burkhart and others. It is proposed to establish a factory.

The Ryan-Todd Manufacturing Company, only recently formed and incorporated, are to build a large plant at Vincennes, Ind., for the manufacture of steel and sheet iron products, boilers, tanks, etc

It is reported that the United States Steel Corporation has secured land at Stinesville, Ind., and will erect machine shops, stone crushing and refining mills, electric-light plant, etc., at a cost of over $1,000,000.

The Acme Match Company, a new concern, capitalized at $100,000, will erect a plant in Roanoke, Va., which will consist of four buildings. Kenneth Lockett, of Orr & Lockett, Chicago, Ill., is president.

The Fort Madison (Iowa) Plow Company has filed articles of incorporation. The new company succeeds the Morrison Manufacturing Company and will overhaul plant, installing new machines where necessary.

Plans are being prepared for the American can & British Manufacturing Company, Providence, R. I., for buildings to replace those recently destroyed by fire. These will include machine shop and power house.

The International Car Company has been incorporated at New Orleans, La., with $350,000 capital to establish a railroad car rebuilding and repair plant. Directors, A. T. LeBaron, Seely Dunn, A. Wagatha and others.

It is reported that the citizens of Shelby, Ohio, will erect a tube plant to replace the one of the United States Steel Company recently burned. Plans have been drawn by J. C. Fish, president of the Business Men's Association.

The Grant Iron Works, Houston, Tex., organized with $50,000 capital has completed shop buildings and is ready to install machinery. The company will handle the repairs and rebuilding of locomotives, cars, sawmills, etc.

The Thomas Locomotive Stoker Company, Cincinnati, Ohio, has been incorporated for the purpose of manufacturing automatic stokers. J. R. Luckes, of Norwood, Ohio; O. P. Thomas, of Los Angeles, and others, incorporators.

The Philadelphia & Reading Railway Company has obtained permit for the erection of power-house, blacksmith shop, paint shop, etc., on Lehigh avenue, Philadelphia. H. D. Taylor, Reading, superintendent motive power.

The Fort Worth (Tex.) Iron and Steel Company will be organized and plant enlarged for the manufacture of bolts, nuts, etc. A department for making car wheels may also be added. G. W. Armstrong, Fort Worth, president.

The J. C. Lauber Company, South Bend, Ind., has been incorporated to manufacture sheet-metal products and to do a general roof-constructing business. Capital, $100,000. Incorporators, J. C. Lauber, O. J. Klaer and E. Lauber.

It is reported that the Harlan & Hollingsworth Corporation, in connection with the Bethlehem Steel Company, with which it is associated, will build what is expected to be the largest steel car plant in the country at Wilmington, Del.

Bids will be opened by the Isthmian Canal Commission, Washington, D. C., under Circular No. 462 for supplies among which there appears the following items: Reamers, track levels, pneumatic drills, electric motors, water meters, emery grinders.

The Cooper Carriage Woodwork Company, St. Louis, Mo., a new concern, will erect a plant for the manufacture of woodwork for carriages.

D. P. Cooper, of the J. A. and D. P. Cooper Company, of Struthers, Ohio, is at the head of the new company.

The Conklin Stove Manufacturing Company, Columbus, Ohio, has been incorporated with $35,000 capital to manufacture stoves and ranges and conduct a general stove foundry business. J. W. Hastings, F. M. Haberkorn and others, incorporators.

Interstate Supply Company, Petersburg, Va., recently incorporated, will establish plant for making doors, sash, etc. Will install machinery at a cost of $10,000. A. L. Miller, superintendent of Homestead Corporation, Monticello Arcade, Norfolk, Va., should be addressed.

The Nashville & Lewisburg Railway Company has applied for a charter to build a line from Nashville to Lewisburg, Tenn., a distance of about 50 miles, to be operated by either electricity or steam. Incorporators, E. R. Richardson, Edgar Jones, J. A. Thompson, of Nashville, and others.

Robert H. Ingersoll & Brother, of New York, makers of the Ingersoll dollar watch, have purchased the plant of the Trenton Watch Company, at Trenton, N. J., and will put same in operation immediately. It is reported that the company will enter a new field and produce more expensive watches.

It is stated that a new industry for the production of refined and common bar iron will be established in Toledo, Ohio, which will employ about 400 men. W. W Lindsey, of Detroit, Mich., is promoter of the enterprise, in which J. B. Patterson, of the Dominion Steel and Iron Company, of Toronto, is interested.

Acting in the capacity of purchasing agent for other parties, H. W. Dexter, 96 Liberty street, New York City, is interested in the purchase of general machine-shop equipment and has considerable inquiries for engine lathes, pulley lathes, wheel lathes, planers, shapers, radial drills, upright drills, bolt and nut machinery, presses, pipe-threading machines, welders, compressors, etc., etc.

The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will open bids as follows: Opening September 1, schedule 234 twist drills; schedule 230, iron castings; schedu e 231, miscellaneous metals, steel forgings and castings; schedule 238, milling machine; schedule 239, plate joggling machine, schedule 240, tapering machine; schedule 241, slotting machine; schedule 242, welding apparatus; schedule 228, punch and shear.

Want Advertisements

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper list free. E. G. Smith Co., Columbia, Pa.

Small, accurate drill jigs and dies built to order. R. Rosner, Madison, Wis.

If you use small gears in large quantities, write Berry & Parker, Erie, Pa.

Steel case hardened; modern methods. Boston Gear Works, Norfolk Downs, Mass.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Wanted—Orders for brass goods. Castings and finished product. Box 411, AMER. MACH.

Hand power bending tools, labor-saving, money-making. Estep & Dolan, Sandwich, Ill.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Special machinery accurately built. Screw machine and turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Wanted—Machinery or machine parts to build by contract. Ideas developed; drawings made. Address "A," care AMER. MACH.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Machinery built to order and by contract; special parts made; gear cutting, automobile and pattern work, punch press and screw machine work, tools, dies, etc. Blair Tool and Machine Works, West and Morris streets, New York City.

Wanted—First-class machine shop in the most rapidly growing city on the Pacific coast: Eugene, home of the State University and hub of the famous Willamette Valley. Address Department M B, Commercial Club, Eugene, Oregon.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

MASSACHUSETTS

Draftsman and designer, practical mechanic, technical education, wide experience. Box 414, AMERICAN MACHINIST

Position as shop manager by practical mechanical engineer with excellent experience and references. Can buy interest in good prospect. Box 393, AMERICAN MACHINIST.

Position by an American as superintendent or assistant superintendent. Practical man with drafting-room experience. Executive ability. Reference. Box 386 AMER. MACH.

MICHIGAN

An A-1 screw machine foreman, good executive and systematizer; designer of tools and cams; expert on Brown & Sharpe, Cleveland, Acme, Spencer and Hartford automatics and the several makes of hand machines, at present employed, would accept offer of a similar position; prefer small town. American, married, age 30. Box 408, AMERICAN MACHINIST.

NEW JERSEY

Designer, labor-saving devices, jigs and fixtures. Can show rapid results. Box 399, AMERICAN MACHINIST.

Mechanical engineer, 8 years designing and erecting condensers, pump engines; pipe work for power plants. Box 401, AMERICAN MACH.

Designer, experienced on automatic and special machinery, close and accurate. References. Box 410, AMERICAN MACHINIST.

Position as assistant superintendent or general foreman; desires a change; up-to-date in modern shop methods and cost system, energetic, executive ability, and a hustler. Box 416, AMERICAN MACHINIST.

NEW YORK

Mechanical engineer, I. C. S. graduate, 30, desires position as junior draftsman; good references as to character and ability. Box 415, AMERICAN MACHINIST.

Machine designer, draftsman and general all-round machinist, with inventive ability and a hustler, 20 years' experience, wishes position. Box 417, AMERICAN MACHINIST.

Machinist, toolmaker, expert all branches, designing tools, foremanship, inventive, ingenious, desires position where high-class mechanic is desirable. Box 412, AMER. MACH.

Wanted—Mechanical superintendency. One of the live ones, up to the minute in modern shop practice. Any location. Ready for engagement at once. Box 337, AMERICAN MACHINIST.

A practical mechanic familiar with making and designing tools and up-to-date factory and foundry management, reducing costs with a minimum friction, 12 years as superintendent of factories making interchangeable machinery and sheet metal parts, wishes to correspond with parties in need of his services. Box 384, AMERICAN MACHINIST.

Experimental designer and engineer, graduate, age 31. Extensive experience fine apparatus, adding machines, typewriters, automatic machinery, developing intricate devices for manufacture. Exceptionally able. Box 405, AMER. MACHINIST.

OHIO

Superintendent of pattern shop and foundry, 15 years' experience and can mix by analysis. Can get results without friction. Box 404, AMERICAN MACHINIST.

PENNSYLVANIA

Expert cost accountant and systematizer desires an executive connection with manufacturing concern. Up-to-date methods and satisfactory results guaranteed. Box 304, AMERICAN MACHINIST.

Chief draftsman, now with large company, 20 years' diversified experience, thoroughly practical and up to date, desires change. Box 409, AMERICAN MACHINIST.

A young and up-to-date mechanic, with 17 years' experience on tools, dies and experimental work; have also held position as inspector; would accept any position of trust. Box 418, AMERICAN MACHINIST.

———Help

Help Wanted

Classification indicates present address of advertiser, nothing else.

ILLINOIS

Wanted—A man capable of drawing new alloy wire, using diamond dies. State salary expected and experience. Box 402, AM. MACH.

Wanted—Designing draftsmen. Thoroughly experienced on water-wheel work. Desirable positions open immediately for satisfactory men. Apply giving experience in full and earliest date of reporting for duty. Box 403, AMER. MACH.

MASSACHUSETTS

Draftsman wanted with experience at machine work. Address, stating age, experience and pay required. Golding Mfg. Co., Franklin, Mass.

NEW YORK

Wanted—Young man to sell a special machine tool in New York territory. Must be willing to start on commission and small salary. Box 419, AMERICAN MACHINIST.

Wanted—Mechanical engineer to supervise work of drawing office and tool department in metal working plant employing over 1000 hands. Must have had practical experience in designing and constructing special equipment used in making small interchangeable mechanisms. Executive ability and good judgment in handling men a requisite. Man familiar with master plate methods used in the manufacture of watches, clocks, guns, typewriters and sewing machines preferred. State experience in detail, give age, salary expected and references. Box 413, AMERICAN MACHINIST.

OHIO

Wanted—Mechanic who thoroughly understands the manufacture of taps and dies. Capable taking charge of department with reliable concern. Good opening. State experience and former connections. Box 388, AMER. MACH.

PENNSYLVANIA

Wanted—Young man familiar with the erection and testing of high-speed automatic engines. One who has had some outside erecting experience preferred. To receive consideration give full details of experience, employer's name, duration and compensation last two engagements. Box 407, AMERICAN MACHINIST.

WISCONSIN

Wanted—For a high grade manufacturing concern, a man who is a thorough mechanic, who thoroughly understands assembling and machine work, to take position of inspector. Must be a man of force and at the same time a man who has a faculty of getting along with those with whom he comes in contact. State past experience, with whom, age, etc. Factory is equipped with best machinery and tools and normally employs about 600 men. Box 406, AMERICAN MACHINIST.

For Sale

For Sale or Rent—Foundry, machine and wood shops with machinery in town of 5000. Box 227, Bergen, N. Y.

For Sale—Foundry and machine shop, well equipped and successfully running under lease, at Baker City, Oregon. A great bargain for cash. Address A. J. Schumacher, 160 S. W. Temple St., Salt Lake City, Utah.

For Sale—Tracings, patterns, jigs and templets for the following size gas and gasolene engines: 1½, 3 and 5 horse-power vertical and 3, 5, 8, 10, 12, 16 and 20 horse-power horizontal; also a number of finished and unfinished engines of the above sizes. All of the above sizes have been in successful operation for several years. This is a splendid opportunity for anyone wishing to build gas or gasolene engines. You can save thousands of dollars in experimental work by purchasing this complete outfit. Shop rights of valuable patents on these engines will be given to purchaser. Box 366, AMERICAN MACHINIST.

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Pratt Chuck Co., Frankfort, N. Y.
Skinner Chuck Co., New Britain, Conn.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitman & Barnes Mfg. Co., Chicago, Ill.
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Compressors, Air
Blaisdell Machinery Co., Bradford, Pa.
Bury Compressor Co., Erie, Pa
Clayton Air Compressor Works, New York.
Independent Pneumatic Tool Co. Chicago, Ill.
Ingersoll-Rand Co., New York.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas
Blaisdell Machinery Co., Bradford, Pa.
Ingersoll-Rand Co., New York.

Conduit, Interior
Sprague Electric Co., New York.

Cones, Friction
Evans Friction Cone Co., Newton Centre, Mass.

Connecting Rods and Straps
Standard Connecting Rod Co., Beaver Falls, Pa.

Contract Work
Blanchard Mach. Co., Cambridge, Mass.
Cell Drier Mach. Co., Taunton, Mass.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Manville Bros. Co., Waterbury, Conn.
Merritt, Jos., Hartford, Conn.
Owen Machine Tool Co., Springfield, Ohio.
Schaeffer Mach. Wks., Phila., Pa.
Turner Mach. Co., Danbury, Conn.

Controllers and Starters, Electric Work
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Conveyors, Automatic
Lamson Consolidated Store Service Co., Boston, Mass.
Link-Belt Co., Philadelphia, Pa.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Corundum
See Grinding Wheels.

Cotters
Cleveland Twist Drill Co., Cleveland, Ohio.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Tool Co., Cleveland, O.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores
Cleveland Twist Drill Co., Cleveland, Ohio.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Counters, Revolution
Root Co., C. J., Bristol, Conn.
Schuchardt & Schutte, New York.
Veeder Mfg. Co., Hartford, Conn.

Countershafts
Almond Mfg. Co., T. R., Ashburnham, Mass.
Builders Iron Foundry, Providence, R. I.
Coates Clipper Mfg. Co., Worcester, Mass.
Evans Friction Cone Co., Newton Centre, Mass.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Mossberg Wrench Co., Central Falls, R. I.
Norton Grinding Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction
Evans Friction Cone Co., Newton Centre, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Counting and Printing Wheels
Franklin Mfg. Co., H. H., Syracuse, N. Y.

Couplers, Hose
Independent Pneu. Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.

Couplings
Almond Mfg. Co., T. ., Ashburnham, Mass.
Caldwell & Son Co., H. W., Chicago, Ill.
Davis Machine Co., W. P., Rochester, N. Y.
Link-Belt Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Williams Fdry. & Mach Co., Akron, Ohio.

Cranes
Brown Hoisting Mach. Co., Cleveland, O.
Case Mfg. Co., Columbus, O.
Cleveland Crane & Car Co., Wickliffe, Ohio.
Crescent Forgings Co., Oakmont, Pa.
Manning, Maxwell & Moore, Inc., New York.
Maris Bros., Philadelphia, Pa.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York

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Niles-Bement-Pond Co., New York.
Underwood & Co., H B., Philadelphia, Pa.

Crank Shafts
Standard Connecting Rod Co., Beaver Falls, Pa.

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Dixon Crucible Co., Joseph, Jersey City, N. J.
Obermayer Co., S., Cincinnati, C.

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Farrel Fdry. & Mach. Co., Ansonia, Conn.
Niles-Bement-Pond Co., New York.
Link-Belt Co., Philadelphia, Pa

Cupolas, and Ladles, Foundry
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.

Cups, Grease
Lunkenheimer Co., Cincinnati, O.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hardinge Bros., Chicago, Ill.
Harrison & Knight Mfg. Co., Newark, N. J.
Ingersoll Milling Mach. Co., Rockford, Ill.
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Pratt & Whitney Co., Hartford, Conn.
Rogers Works, Jno. M., Gloucester City, N. J.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Ward & Son, Edgar T., Boston, Mass.
Whitney Mfg. Co., Hartford, Conn.

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Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Davis Machine Co., W. P., Rochester, N. Y.
Huriburt-Rogers Mach. Co., South Sudbury, Mass.
McCabe, J. J., New York.
Newton Mach. Tool Wks., Inc., Philadelphia Pa.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Schmitz, August, Dusseldorf, Germany.
Vandyck Churchill Co., New York.

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Billings & Spencer Co., Hartford, Conn.
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Fitchburg Machine Works, Fitchburg, Mass.
Krieger Tool & Mfg. Co., Chicago, Ill
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

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American Emery Wheel Co., Providence, R. I.
Dickinson, Thos. L., New York.
Safety Emery Wheel Co., Springfield, O.

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Bliss Co., E. W., Brooklyn, N. Y.
Consolidated Press and Tool Co., Hastings, Mich.
Ferracute Mach. Co., Bridgeton, N. J.
Globe Machine & Stamping Co., Cleveland, O.
Manville Bros. Co., Waterbury, Conn.

Dies, Sub-Press
Sloan & Chace Mfg. Co., Newark, N. J.
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening
Errington, F. A., New York.
Foote-Burt Co., Cleveland, O.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Machine Co., Springfield, Vt.
Pratt & Whitney Co., Hartford, Conn.

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Drawing Materials
Alteneder & Son, Theo.. Philadelphia, Pa.
Kolesch & Co., New York.

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Universal Drafting Mach. Co., Cleveland, O.

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Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Ingersoll-Rand Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Rockford Drilling Mach. Co., Rockford, Ill.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Boiler
American Tool Works Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Foote-Burt Co., The, Cleveland, O.
Ingersoll-Rand Co., New York.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.

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American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Flather Planer Co., Mark, Nashua, N. H.
Foote-Burt Co., The, Cleveland, Ohio.
Fosdick Mach Tool Co., Cin., O.
Hardinge Bros., Chicago, Ill.
Harrington Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
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Newton Mach. Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill
Sellerr & Co., Inc., Wm., Philadelphia, Pa.
Slate Machine Co., Dwight, Hartford, Conn.
Taylor & Fenn Co., Hartford, Conn.

Drilling Machines, Portable
Cincinnati Elec. Tool Co., Cin., O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Hisey-Wolf Mach. Co., Cin., O.
Ingersoll-Rand Co., New York.
Newton Machine Tool Wks., Inc., Phila., Pa.
Niles-Bement-Pond Co., New York.
Stow Mfg. Co., Binghamton, N. Y.
U. S. Electrical Tool Co., Cincinnati, O.

Drilling Machines, Radial
American Tool Works Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
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Fitchburg Machine Works, Fitchburg, Mass.
Foote-Burt Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
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Niles-Bement-Pond Co., New York.
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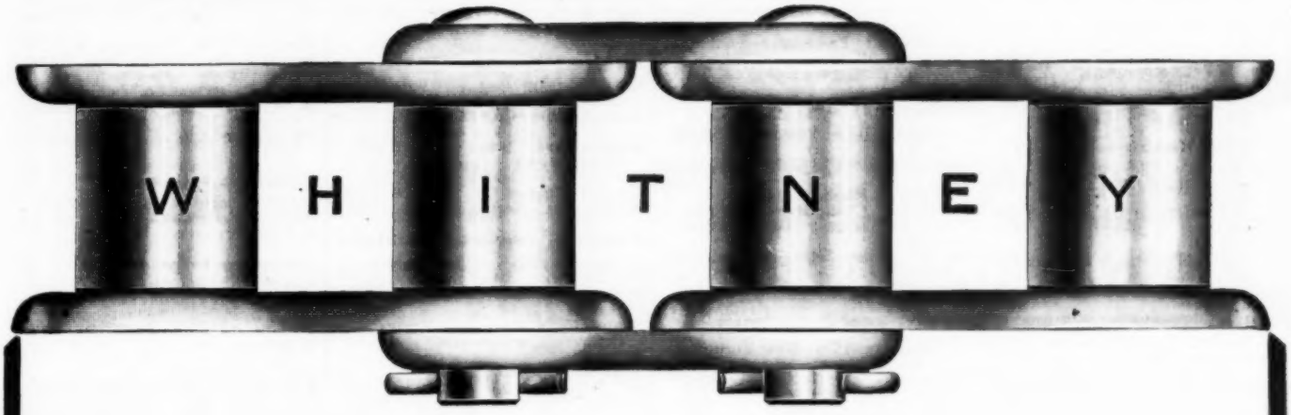

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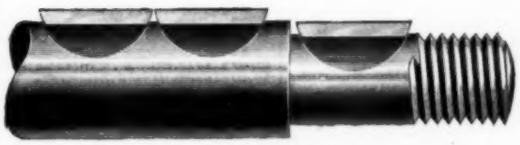

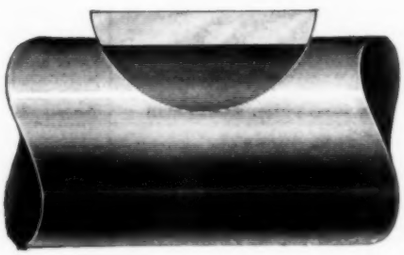

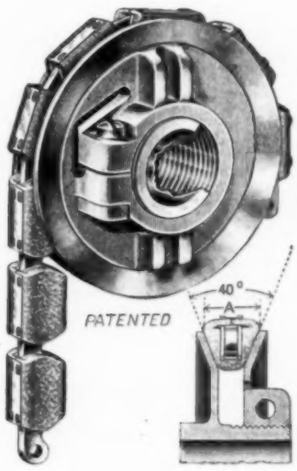

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Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
Standard Tool Co., Cleveland, O.

Drilling Machines, Turret
Fay Machine Tool Co., Phila., Pa.
Niles-Bement-Pond Co., New York.

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Beaman & Smith Co., Prov., R. I.
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Hill, Clarke & Co., Inc., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
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Mechanics Machine Co., Rockford, Ill.
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Slate Machine Co., Dwight, Hartford, Conn.
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Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.

Drills, Electric
Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Independent Pneumatic Tool Co., Chicago, Ill.
Van Dorn Elec. Mfg. Co., Cleveland, Ohio.

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Celfor Tool Co., Chicago, Ill.
Whitman & Barnes Mfg. Co., Chicago, Ill

Drills, Hand
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Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cincinnati, O

Drills, Pneumatic
Clayton Air Compressor Works, New York.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.

Drills, Ratchet
Armstrong Bros. Tool Co., Chicago, Ill.
Cleveland Twist Drill Co., Cleveland, O.
Hisey-Wolf Mach. Co., Cin., O.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers Works, John M., Gloucester City, N. J.
Standard Tool Co., Cleveland, O.

Drills, Rock
Ingersoll-Rand Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.

Drill Speeder
Graham Mfg. Co., Providence, R. I.

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Eck Dynamo & Motor Co., Belleville, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Sprague Electric Co., New York.
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Roth Bros. & Co., Chicago, Ill.
U. S. Electrical Tool Co., Cincinnati, O.
Van Dorn Elec. & Mfg. Co., Cleveland, Ohio.
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See Grinding Wheels.

Emery Wheel Dressers
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Engines, Motor
Franklin Mfg. Co., H. H., Syracuse, N. Y.

Engines, Steam
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.

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Expanders, Tube
Nicholson & Co., W. H., Wilkes-Barre, Pa.

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Crocker-Wheeler Co., Ampere, N. J.
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Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
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Westmacott Gas Furnace Co., Providence, R. I.

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U. S. Gas Furnace Co., Providence, R. I.

Furnaces, Gas
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Westmacott Gas Furnace Co., Providence, R. I.

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American Gas Furnace Co., New York.
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Rockwell Furnace Co., New York.
Tate, Jones & Co., Pittsburg, Pa.

Furniture, Machine Shop
Hart & Cooley Co., New Britain, Conn.
Lyon Metallic Mfg. Co., Aurora, Ill.
Manufacturing Equip. & Engineering Co., Boston, Mass.
Merritt & Co., Philadelphia, Pa.
New Britain Mach. Co., New Britain, Conn.

Gages, Recording
Bristol Co., Waterbury, Conn.

Gages, Standard
Ames & Co., B. C., Waltham, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Grönkvist Drill Chuck Co., Jersey City, N. J.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers Wks., Jno. M., Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gages, Steam
Bristol Co., Waterbury, Conn.
Crosby Steam Gage & Valve Co., Boston, Mass.

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Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
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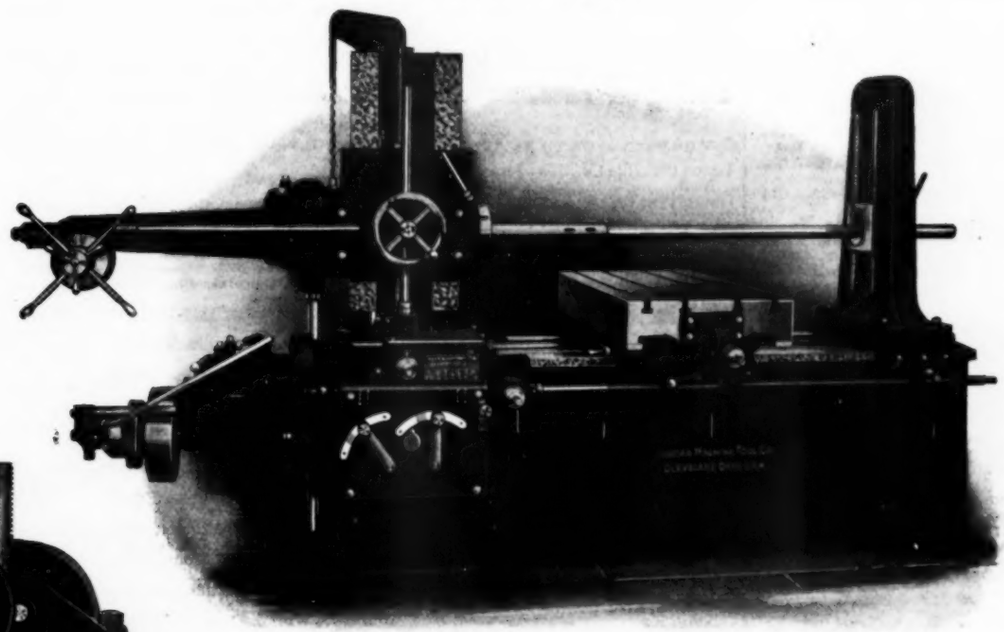

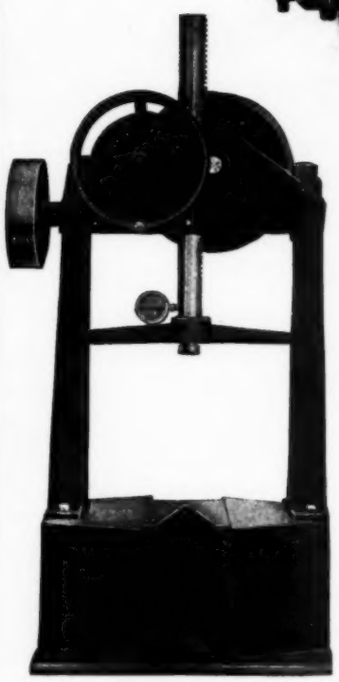

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Gear Cutting Machinery —*Continued.*

Buffalo Gear & Pattern Works, Buffalo, N. Y.
Cincinnati Shaper Co., Cincinnati, Ohio.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
McCabe, J. J., New York.
Newton Machine Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Slate Machine Co., Dwight, Hartford, Conn.
Sloan & Chace Mfg. Co., Newark, N. J.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Van Dorn & Dutton Co., Cleveland, O.
Walcott & Wood Mach. Tool Co., Jackson, Mich.
Waltham Machine Works, Waltham, Mass.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery

Gisholt Mach. Co., Madison, Wis.

Gears, Cut

Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Norfolk Downs, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Buffalo Gear & Pattern Works, Buffalo, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Machine Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Fawcus Mach. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, Mass.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin., Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, Ohio.
Lea Equipment Co., New York.
New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Owen Machine Tool Co., Springfield, Ohio.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Works, Cleveland, O.
Spacke Mach. Co., F. W., Indianapolis, Ind.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton Co., Cleveland, O.
Walcott & Wood Mach. Tool Co., Jackson, Mich.

Gears, Molded

Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., H. H., Syracuse, N. Y.
Horsburg & Scott Co., Cleveland, Ohio.
Philadelphia Gear Works, Philadelphia, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton Co., Cleveland, O.

Gears, Rawhide

Boston Gear Works, Norfolk Downs, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Earle Gear & Mach. Co., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Horsburg & Scott Co., Cleveland, O.

Gears, Rawhide—*Continued.*

New Process Rawhide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Works, Cleveland, O.
Van Dorn & Dutton Co., Cleveland, O.

Gears, Worm

Albro-Clem Elevator Co., Philadelphia, Pa.
Boston Gear Works, Norfolk Downs, Mass.
Eberhardt Bros. Mach. Co., Newark, N. J.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Fawcus Mach. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburg & Scott Co., Cleveland, O.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Taylor-Wilson Mfg. Co., McKees Rocks, Pa.
Van Dorn & Dutton Co., Cleveland, O.

Generating Sets

Burke Electric Co., Erie, Pa.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Electrical Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Sprague Electric Co., New York.
Sturtevant Co, B. F., Hyde Park, Mass.
Triumph Electric Co., Cincinnati, O.

Generators, Gas

American Gas Furnace Co., New York.

Graphite

Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Center

Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Gem Mfg. Co., Pittsburg, Pa.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincinnati, O.
Mueller Machine Tool Co., Cincinnati, O.
Niles-Bement-Pond Co., New York.
U. S. Electrical Tool Co., Cin., O.

Grinders, Cutter

Becker Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Crocker-Wheeler Co., Ampere, N. J.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll Milling Mach. Co., Rockford, Ill.
McCabe, J. J., New York.
National Machine Co., Hartford, Conn.
Niles-Bement-Pond Co., New York.
Norton Grinding Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
U. S. Electrical Tool Co., Cincinnati, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Cylindrical

Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., Worcester, Mass.
Landis Tool Co., Waynesboro, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disc

Besly & Co., Chas. H., Chicago, Ill.
Diamond Machine Co., Providence, R. I.
Gardner Machine Co., Beloit, Wis.

Grinders, Disc —*Continued.*

Heald Mach. Co., Worcester, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Safety Emery Wheel Co., Springfield, Ohio.
Taylor & Fenn Co., Hartford, Conn.

Grinders, Drill

Heald Mach. Co., Worcester, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Safety Emery Wheel Co., Springfield, Ohio.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
U. S. Electrical Tool Co., Cincinnati, Ohio.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Internal

Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., Worcester, Mass.
Landis Tool Co., Waynesboro, Pa.
Rivett Lathe Mfg. Co., Boston, Mass.
U. S. Electrical Tool Co., Cincinnati, O.

Grinders, Knife

American Wood Working Mchy. Co., Rochester, N. Y.
Safety Emery Wheel Co., Springfield, O.

Grinders, Portable

Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Coates Clipper Mfg. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincinnati, O.
U. S. Electrical Co., Cincinnati, Ohio.

Grinders, Tool

Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Blount Co., J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Cincinnati Milling Machine Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., James, Louisville, Ky.
Diamond Machine Co., Providence, R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Grant Mfg. & Mach. Co., Bridgeport, Conn
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
McCabe, J. J., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Mummert, Wolf & Dixon Co., Hanover, Pa.
Niles-Bement-Pond Co., New York.
Norton Grinding Co., Worcester, Mass.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett Lathe Mfg. Co., Boston, Mass.
Rockford Drilling Mach. Co., Rockford, Ill.
Safety Emery Wheel Co., Springfield, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Tabor Mfg. Co., Phila., Pa.
U. S. Electrical Tool Co., Cincinnati, O.
Vandyck Churchill Co., New York
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Conn
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding or Polishing Machinery

Abrasive Material Co., Philadelphia, Pa.
American Emery Wheel Co., Providence, R. I.
Barnes Co., W. F. & John, Rockford, Ill.
Besly & Co., Chas. H., Chicago, Ill
Blount Co , J. G., Everett, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders Iron Foundry, Providence, R. I.
Chicago Machine Tool Co., Chicago, Ill.

Grinding or Polishing Machinery—*Continued.*

Cincinnati Electrical Tool Co., Cincinnati, O.
Clark, Jr., Elec. Co., Inc., Jas., Louisville, Ky.
Coates Clipper Mfg. Co., Worcester Mass.
Crocker-Wheeler Co., Ampere, N. J
Diamond Machine Co., Providence R. I.
Gardner Mach. Co., Beloit, Mich.
Harrington, Son & Co., Edwin Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Inc., Boston, Mass.
Hisey-Wolf Mach. Co., Cincinnati, O.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Electrical Mfg. Co., Madison, Wis
Norton Grinding Co., Worcester, Mass.
Pittsburg Emery Wheel Co., Pittsburg, Pa.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Roth Bros. & Co., Chicago, Ill.
Safety Emery Wheel Co., Springfield, O.
U. S. Electrical Tool Co., Cincinnati, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.

Grinding Wheels

Abrasive Material Co., Philadelphia, Pa.
Adams Co., Dubuque, Iowa.
American Emery Wheel Co., Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Coates Clipper Mfg. Co., Worcester, Mass.
Diamond Machine Co., Providence, R. I.
Dickinson, Thos. L., New York.
Niles-Bement-Pond Co., New York.
Norton Co., Worcester, Mass.
Pittsburg Emery Wheel Co., Pittsburg, Pa.
Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Conn.

Grindstones and Frames

Cleveland Stone Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Norton Co., Worcester, Mass.

Gun Barrel Machinery

Diamond Machine Co., Providence, R. I.
Pratt & Whitney Co., Hartford, Conn.
Reed Co., F. E., Worcester, Mass.

Hammers, Drop

Bliss Co., E. W., Brooklyn, N. Y.
Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Hammers, Pneumatic

Bliss Co., E. W., Brooklyn, N. Y.
Clayton Air Compressor Works, New York.
Independent Pneumatic Tool Co. Chicago, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Hammers, Power

Bradley & Son, C C., Syracuse, N. Y.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Hammers, Steam

Bethlehem Foundry & Machine Co., South Bethlehem, Pa.
Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Crescent Forgings Co., Oakmont, Pa.
Marshall & Huschart Machinery Co., Chicago, Ill.
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Hammers, Steam—*Continued.*
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Vandyck Churchill Co., New York.

Hardening and Tempering Process
Metal Hardening Solution Co., Rochester, N. Y.

Heading Machinery, Cold
Manville Mach. Co., E. J., Waterbury, Conn.

Heaters, Feed Water
Sturtevant Co., B. F., Hyde Park, Mass.

Heating and Ventilating Apparatus
Sturtevant Co., B. F., Hyde Park, Mass.

Heating Machines
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.
Rockwell Furnace Co., New York.

Hobbing Machines, Worm
Gould & Eberhardt, Newark, N. J.
Newton Machine Tool Wks., Inc., Phila., Pa.
Pratt & Whitney Co., Hartford, Conn.
Schuchardt & Schutte, New York.

Hoisting and Conveying Machinery
Brown Hoisting Machinery Co., Cleveland, O.
Caldwell & Son Co., H. W., Chicago, Ill.
Cleveland Crane & Car Co., Wickliffe, O.
Link-Belt Co., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.
Yale & Towne Mfg. Co., New York.

Hoists, Electric
C & C Electric Co., New York.
Case Mfg. Co., Columbus, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.
Sprague Electric Co., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Hand
Case Mfg. Co., Columbus, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Nicholls, Wm. S., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Northern Engineering Works, Detroit, Mich.
Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.

Hones
Carborundum Co., Niagara Falls, N. Y.

Hose, Air
Independent Pneumatic Tool Co., Chicago, Ill.

Hose, Steel
Sprague Electric Co., New York.

Igniters, Gas Engine
Franklin Mfg. Co., H. H., Syracuse, N. Y.

Indicators, Speed
Warner Instrument Co., Beloit, Wis.

Indicators, Steam Engine
Crosby Steam Gage & Valve Co., Boston, Mass.

Indicators, Test
Boulet's Fine Tool Wks., Beverly, Mass.
Grant Mfg. & Mach. Co., Bridgeport, Conn.
Norton Grinding Co., Worcester, Mass.
Starrett Co., L. S., Athol, Mass.

Injectors
Desmond-Stephan Mfg. Co., Urbana, O.
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Inspection and Tests
Hunt Co., Robert W., Chicago, Ill.

Iron Bar
Milton Mfg. Co., Milton, Pa.

Jacks, Hydraulic
Bethlehem Foundry & Machine Co., South Bethlehem, Pa.
Elmes Engineering Works, Chas. F., Chicago, Ill.
Watson-Stillman Co., New York.

Jacks, Planer
Armstrong Bros. Tool Co., Chicago, Ill.

Kettles, Soda
Brown & Sharpe Mfg. Co., Providence, R. I.
Mfg. Equip. & Engineering Co., Boston, Mass.

Key Seaters
Baker Bros., Toledo, O.
Burr & Sons, John T., Brooklyn, N. Y.
Davis Machine Co., W. P., Rochester, N. Y.
Lapointe Mach. Tool Co., Hudson, Mass.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Mitts & Merrill, Saginaw, Mich.
Morton Manufacturing Co., Muskegon Heights, Mich.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Rockford Drilling Mach. Co., Rockford, Ill.
Whitney Mfg. Co., Hartford, Conn.

Keys, Machine
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Conn.

Knives, Machine
Coes Wrench Co., Worcester, Mass.
Simonds File Co., Fitchburg, Mass.

Lamps, Arc
General Electric Co., New York.
Western Electric Co., Chicago, Ill.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lathe Attachments
American Tool Works Co., Cin., O.
Bradford Machine Tool Co., Cincinnati, O.
Fitchburg Machine Works, Fitchburg, Mass.
LeBlond Machine Tool Co., R. K., Cincinnati, Ohio.
Mossberg Wrench Co., Central Falls, N. Y.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe Mfg. Co., Boston, Mass.
Sebastian Lathe Co., Cincinnati, O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Sloan & Chace Mfg Co., Newark, N. J.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.
Williams & Co., J. H., Brooklyn, N. Y.

Lathes
American Tool & Machine Co., Boston, Mass.
American Tool Works Co., Cin., O.
Automatic Mach. Co., Bridgeport, Conn.
Barnes Co., W. F. & John, Rockford, Ill.
Blount Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cincin., O.
Bridgeford Mach. Tool Works, Rochester, N. Y.
Bullard Mach. Tool Co., Bridgeport, Conn.
Champion Tool Works Co., Cincinnati, O.

Lathes—*Continued.*
Cincinnati Lathe and Tool Co., Cincinnati, O.
Davis Machine Co., W. P., Rochester, N. Y.
Dreses Machine Tool Co., Cin., O.
Fay Mach. Tool Co., Phila., Pa.
Fay & Scott, Dexter, Me.
Fitchburg Machine Works, Fitchburg, Mass.
Garvin Mach. Co., New York.
Gisholt Mach. Co., Madison, Wis.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Morris Foundry Co., Jno. B., Cincinnati, O.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentice Bros. Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Rockford Drilling Mach. Co., Rockford, Ill.
Schumacher & Boye, Cincinnati, O.
Sebastian Lathe Co., Cincinnati, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Springfield Mach. Tool Co., Springfield, O.
Toomey, Frank, Philadelphia, Pa.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.
Walcott & Wood Mach. Tool Co., Jackson, Mich.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Wormer Mchry. Co., C. C., Detroit, Mich.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.
Fay Machine Tool Co., Phila., Pa.
Pratt & Whitney Co., Hartford, Conn
Prentiss Tool & Supply Co., New York.

Lathes, Bench
American Watch Tool Co., Waltham, Mass.
Ames & Co., B. C., Waltham, Mass.
Blount Co., J. G., Everett, Mass.
Hardinge Bros., Chicago, Ill.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sebastian Lathe Co., Cincinnati, O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Stark Tool Co., Waltham, Mass.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.
Taylor & Fenn Co., Hartford, Conn.
Waltham Machine Works, Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
American Wood Working Machry. Co., Rochester, N. Y.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Lathes, Brass
Bardons & Oliver, Cleveland, O.
Dreses Mach. Tool Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Springfield Mch. Tool Co., Springfield, O.
Warner & Swasey Co., Cleveland, O.

Lathes, Extension
Harrington & Sons Co., Edwin, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Lathes, Foot Power
Barnes Co., W. F. & Jno., Rockford, Ill.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Lathes, Gap
American Tool Wks. Co., Cin., O.
Fay & Scott, Dexter, Me.
Harrington & Sons Co., Edwin, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Sebastian Lathe Co., Cincin., O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Lathes, Portable
Lodge & Shipley Machine Tool Co., Cincinnati, O.

Lathes, Speed
Blount Co., J. G., Everett, Mass.
Chicago Machine Tool Co., Chicago, Ill
LeBlond Machine Tool Co., R. K., Cincinnati, O.
Niles-Bement-Pond Co., New York.
Sebastian Lathe Co., Cincin., O.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Lathes, Wood
American Wood Working Mchy Co., Rochester, N. Y.
Barnes Co., W. F. & John, Rockford, Ill.
Fay & Scott, Dexter, Me.
Prentiss Tool & Supply Co., New York.

Levels
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
General Fire Proofing Co., Youngstown, Ohio.
Hart & Cooley Co., New Britain, Conn.
Lyon Metallic Mfg. Co., Aurora, Ill.
Merritt & Co., Philadelphia, Pa.
Manufacturing Equipment & Engineering Co., Boston, Mass.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill
Gem Mfg. Co., Pittsburg, Pa.

Machinery Dealers
Besly & Co., Chas. H., Chicago, Ill.
Chandler & Farquhar, Boston, Mass.
Garvin Mach. Co., New York.
Hill, Clarke & Co., Inc., Boston, Mass.
Lea Equipment Co., New York.
Manning, Maxwell & Moore, Inc., New York.
Marshall & Huschart Machry. Co., Chicago, Ill.
McCabe, J. J., New York.
Motch & Merryweather Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Schuchardt & Schutte, New York.
Toomey, Frank, Philadelphia, Pa.
Vandyck Churchill Co., New York.
Wormer Mach. Co., C. C., Detroit, Mich.

Machine Screw Work
Natl. Acme Mfg. Co., Cleveland, O.
Screw Machine Products Corp., Providence, R. I.
Universal Machine Screw Co., Hartford, Conn.

Machinists' Small Tools
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Boulet's Fine Tool Wks., Beverly, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Pratt & Whitney Co., Hartford Conn.
Schuchardt & Schutte New York.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O
Starrett Co., L. S., Athol, Mass.